THE UNIVERSITY
OF ILLINOIS
LIBRARY
630
Un3f
No. 1101-25

AGRICULTURAL
LIBRARY

NON CIRCULATING

CHECK FOR UNBOUND
CIRCULATING COPY

m3f
1101-1125
Ag Sem

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF PUBLICATIONS

UNIVERSITY OF ILLINOIS
AGRICULTURE LIBRARY

21980
'24

FARMERS' BULLETINS

Nos. 1101-1125

WITH CONTENTS AND INDEX

PREPARED UNDER THE SUPERVISION OF
JOHN L. COBBS, Jr.
CHIEF, DIVISION OF PUBLICATIONS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

630
Un3f
No. 1101-25

Ag. Sem.

CONTENTS.

FARMERS' BULLETIN No. 1101.—THE ARGENTINE ANT AS A HOUSEHOLD PEST:

Page.

A pest both in the household and on the farm 3
Importance in agriculture 4
Nesting habits 4
Scattered from Texas to the Atlantic with infestations in California 5
How new territory is gained 5
The nest flooded, a colony may form a compact ball and float away 5
Various forms 6
Control 6
    Natural control not effective 6
    How to keep ants from trees 6
    How to keep ants from tables, etc., in an infested house 7
    Strong ant poisons 8
    A sirup made according to a special formula most satisfactory 8
    Plans for municipal control work 11
    Trapping ants 11

FARMERS' BULLETIN No. 1102.—THE CROW IN ITS RELATION TO AGRICULTURE:

Distribution and abundance 4
Life history 5
Economic status 7
    Animal food 7
    Vegetable food 11
Protection of crops and poultry 15
Summary 19

FARMERS' BULLETIN No. 1103.—GROWING IRRIGATED GRAIN IN SOUTHERN IDAHO:

Cereals important in Idaho 3
The Snake River basin 4
Leveling for irrigation 7
Leveling and tilling machinery 8
Seed-bed preparation 9
Cereals in the rotation 10
Seed and seeding 12
Methods of irrigation 14
Results at the Aberdeen substation 18
Harvesting and thrashing 26

FARMERS' BULLETIN No. 1104.—BOOK LICE OR PSOCIDS:

Their habits and where they thrive 2
Conditions favorable to their increase 3
How to control book lice in houses 4

FARMERS' BULLETIN No. 1105.—CARE OF MATURE FOWLS:

Care of the poultry house 3
Feeding the hens 4
    Egg-laying rations 4
    How to feed 5
    Green feeds, grit, and oyster shells 6
Preparing poultry and eggs for market 7

494058

FARMERS' BULLETIN NO. 1106.—INCUBATION OF HENS' EGGS:

Page.
Selection of eggs for hatching ... 3
Nests for sitting hens ... 3
How to set a hen ... 4
Care of the sitting hen ... 5
Method of testing eggs ... 7
Hatching ... 8

FARMERS' BULLETIN NO. 1107.—BROOD COOPS AND APPLIANCES:

Brood coops for hen and chicks ... 3
Coop for shipping exhibition fowls ... 5
Exhibition coop ... 6
Dry-mash hopper ... 7
Drinking fountain ... 7
Farmers' bulletins on poultry raising ... 8

FARMERS' BULLETIN NO. 1108.—CARE OF BABY CHICKS:

Care at hatching time ... 3
Keep the chicks warm ... 4
Emergency brooder ... 5
Feeding baby chicks ... 6
Farmers' bulletins on poultry raising ... 8

FARMERS' BULLETIN NO. 1109.—PRESERVING EGGS:

Preserving eggs for home use ... 3
    Preserving in water glass ... 3
    Preserving with lime solution ... 4
    Best results ... 4
Using preserved eggs ... 4
An infertile egg ... 5
A fertile egg ... 5
Candling eggs ... 6

FARMERS' BULLETIN NO. 1110.—LICE, MITES, AND CLEANLINESS:

Kinds of lice ... 3
    Body lice ... 4
    Feather lice ... 4
    How to get rid of body and feather lice ... 4
    Head lice ... 5
Poultry mites ... 6
"Stick-tight" fleas ... 7
Poultry ticks, or "blue bugs" ... 8
Chiggers, or "red bugs" ... 8
Dust bath ... 9
Whitewash ... 9
Cleanliness ... 9
Farmers' bulletins on poultry raising ... 10

FARMERS' BULLETIN NO. 1111.—MANAGEMENT OF GROWING CHICKS:

Essentials to proper growth ... 3
    Coops and houses ... 3
    Cleanliness ... 4
    Feeds and water ... 4
    Range and shade ... 6
Keep standard-bred poultry ... 7
Farmers' bulletins on poultry raising ... 8

FARMERS' BULLETIN NO. 1112.—CULLING FOR EGGS AND MARKET:

Proper culling insures profit ... 3
When to cull ... 3
How to tell the good and poor layers ... 4
A guide in culling ... 7
Marketing suggestions ... 8

FARMERS' BULLETIN NO. 1113.—POULTRY HOUSES: Page.
Location.... 4
Floor space.... 4
House for small flock.... 4
House for 50 to 75 hens.... 5
Remodeling poultry houses.... 6
Floors.... 6
Interior arrangement.... 7

FARMERS' BULLETIN NO. 1114.—COMMON POULTRY DISEASES:
Gapes.... 3
Roup.... 4
Chicken pox.... 6
Scaly leg.... 6
Prevention better than cure.... 7
Farmers' bulletins on poultry raising.... 8

FARMERS' BULLETIN NO. 1115.—SELECTION AND PREPARATION OF FOWLS FOR EXHIBITION:
Value of poultry exhibitions.... 3
Selecting the fowls.... 3
Preparation.... 5
Shipping the fowls.... 9
Attending the show.... 10
Farmers' bulletins on poultry raising.... 11

FARMERS' BULLETIN NO. 1116.—SELECTION AND CARE OF POULTRY BREEDING STOCK:
Keep standard-bred stock.... 3
Health and vigor.... 3
Object of breeding.... 4
Time of mating.... 6
Size of matings.... 6
Age of breeding stock.... 7
Free range for the breeding pen.... 8
Maintaining flock fertility.... 8
Housing breeding stock.... 9
Feeding breeding stock.... 9
Farmers' bulletins on poultry raising.... 9

FARMERS' BULLETIN NO. 1117.—FORESTRY AND FARM INCOME:
Why farm forestry pays.... 3
Extent of farm woodlands.... 4
Value of woodland products.... 6
Securing good forest growth.... 7
Improving the woods by cutting.... 11
Estimating and selling timber.... 13
Fire protection.... 21
Grazing and insect damage.... 21
Using timber at home.... 23
Planting forest trees.... 27
Additional information.... 31

FARMERS' BULLETIN NO. 1118.—DOCKAGE UNDER THE FEDERAL WHEAT GRADES:
Dockage described.... 3
Foreign material in wheat.... 5
"Dockage" and "Foreign material other than dockage" distinguished.. 5
Value of dockage.... 7
Detailed description of method of determining dockage.... 8
  Certain foreign material designated as dockage.... 8
  How to secure the sample for inspection.... 8
  Equipment for separating dockage.... 9
  How to use the hand sieves.... 10
Test weight determined on dockage-free wheat.... 20
Grading the dockage-free sample.... 20
Practical methods of handling dockage.... 21
A few improper methods of applying dockage.... 22

FARMERS' BULLETIN No. 1118.—DOCKAGE UNDER THE FEDERAL WHEAT GRADES—Continued.

Page.
Securing information relative to dockage 23
Tabulated wheat standards 24
Post-office addresses of offices of Federal grain supervision 26

FARMERS' BULLETIN No. 1119.—FALL-SOWN OATS:

The fall oat area 3
Advantages of fall over spring seeding 4
Varieties of fall-sown oats 6
Soils and fertilizers 9
Fall oats in the rotation 12
Preparation of the land 13
Preparation of the seed 13
Sowing the seed 14
Treatment of the land after seeding 17
Weeds 18
Harvesting the crop 18
Uses of the oat crop in the South 20

FARMERS' BULLETIN No. 1120.—CONTROL OF APPLE POWDERY MILDEW:

Economic importance of apple powdery mildew 3
Description of the disease 4
Cause of the disease 6
Control measures 7
  Pruning 7
  Spraying 8
  Spray materials 12
Spraying schedule 13

FARMERS' BULLETIN No. 1121.—FACTORS THAT MAKE FOR SUCCESS IN FARMING IN THE SOUTH:

Farm records 3
Farm incomes vary 5
Why do such variations occur? 5
Practices that help to maintain and increase crop yields 8
Influences of systems of farming on yields per acre 16
Practices that lower the grade of the product 18
Influence of quality in dairy cows on income 19
Efficiency in the use of labor 21
Utilizing untillable and waste land 27
Size of the business 28
Organization of farm enterprises 30

FARMERS' BULLETIN No. 1122.—CITRUS-FRUIT GROWING IN THE GULF STATES.

Scope of the work 3
History of the Florida citrus industry 4
History of the citrus industry in the other Gulf States 5
Selection of a locality and site for a grove 7
Kinds of citrus fruits for the Gulf States 11
Varieties of citrus fruits for the Gulf States 15
Propagation of citrus trees 20
Grove management 23
Harvesting and marketing citrus fruits 42
Costs and profits in citrus growing 43
Publications on citrus fruits 45

FARMERS' BULLETIN No. 1123.—GROWING AND PLANTING HARDWOOD SEEDLINGS ON THE FARM.

What trees to grow 3
Planting two or more kinds of trees together 5
Location of plantation or windbreak 6
Establishment of plantation 7
Care of plantation 12
Sources of planting stock 17
Seed collection, extraction, and storage 17
Growing the seedlings 22
Sources of information and advice for the planter 28

FARMERS' BULLETIN NO. 1124.—THE BROWN-SPOT OF CORN, WITH SUGGESTIONS FOR ITS CONTROL.

Page.
Regional distribution of the disease.......... 3
Description of the disease.......... 3
Distribution and prevalence of the disease.......... 3
Damage caused.......... 4
Symptoms.......... 4
Factors influencing the development of the disease.......... 6
Crops diseased.......... 7
Cause of the disease.......... 7
Control measures.......... 9

FARMERS' BULLETIN NO. 1125.—FORAGE FOR THE COTTON BELT.

Southern forage crops highly profitable.......... 3
Soils.......... 3
Hay and pasture grasses.......... 5
Coarse fodder grasses.......... 23
Legumes.......... 28
Miscellaneous forage crops.......... 47
Hay crops.......... 51
Pastures.......... 56
Silage crops.......... 58
Soiling crops.......... 59
Recommendations by the agriculturists of southern experiment stations.......... 60

FARMERS' BULLETIN 1101
UNITED STATES DEPARTMENT OF AGRICULTURE

The ARGENTINE ANT as a HOUSEHOLD PEST

FROM TEXAS TO THE ATLANTIC, in scattered localities, the Argentine ant, in dark brown hordes, attacks gardens, ruining orchard and truck crops, and swarms into the houses, making conditions in some cases so unbearable that their inhabitants leave.

The pest is carried by rail in foodstuffs, and since its original introduction, presumably from Brazil, it has been distributed about the country until infestations occur throughout the South, with a separate group of infestations in California. It may also be carried by floods, such as take place in the Mississippi Valley, the ants forming themselves into a compact ball which floats to safety.

In the warm spring weather the Argentine ant is particularly annoying in households, and thorough methods for its control should be undertaken at that time. On page 6 will be found a formula for a tree-banding mixture that will protect the trees of the nurseryman and orange grower. Various methods for isolating food in the house and a satisfactory ant poison to be used as a protection within doors and without are also described.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. March, 1920

THE ARGENTINE ANT[1] AS A HOUSEHOLD PEST.

E. R. BARBER,
Scientific Assistant, Southern Field Crop Insect Investigations.

CONTENTS.

	Page.		Page.
A pest both in the household and on the farm	3	Control	6
Importance in agriculture	4	Natural control not effective	6
Nesting habits	4	How to keep ants from trees	6
Scattered from Texas to the Atlantic with infestations in California	5	How to keep ants from tables, etc., in an infested house	7
How new territory is gained	5	Strong ant poisons	8
The nest flooded, a colony may form a compact ball and float away	5	A sirup made according to a special formula most satisfactory	8
Various forms	6	Plans for municipal control work	11
		Trapping ants	11

A PEST BOTH IN THE HOUSEHOLD AND ON THE FARM.

ANTS are common and annoyance from them is by no means unknown, yet the Argentine ant has distinguished itself by greatly exceeding other species in its injury. Other ants may make themselves troublesome, but the Argentine ant goes so far as to cause homes to be vacated in an infested neighborhood. It becomes important in agriculture as well, damaging fruit and other crops by its propagation of scale insects.

The worker ants are most commonly seen. Small in size and dark brown in color, they are able to invade practically every part of ordinary dwellings, stores, etc. The Argentine ant is almost omnivorous, eating most cooked foods and a considerable percentage of the raw foods found in the average pantry. It has a marked preference for some things, such as sugar, sirup, honey, jams, cakes, candies, pies, fruit, and meats of all kinds. Even refrigerators and ice boxes are readily invaded, the low temperatures having no deterrent effect. It is a common occurrence for Argentine ants to find their way into bedchambers, and while they do not possess a sting they can cause considerable pain with their mandibles. There have been many reports of babies being attacked by them in such numbers as to cause serious results; several of these reports have been verified.

With conditions made almost intolerable in badly infested places, it is not uncommon to find empty, unrentable houses. Realty values accordingly drop.

---

[1] *Iridomyrmex humilis* Mayr.

IMPORTANCE IN AGRICULTURE.

The nurseryman, the trucker, and the orange grower are greatly molested by this pest, owing to the fondness of the ant for the honeydew excreted by aphids and scale insects. The workers take the best possible care of these honeydew-yielding species, and protect them from their natural enemies, frequently building shelters over them, and as the host plants grow, carry the young scales and aphids and place them on the young tender growth, where they may more easily sap the juices of the plants.

In corn, cotton, and sugar-cane fields, the Argentine ant when present is constantly attending the aphids and mealybugs, increasing the numbers of these species to an alarming degree, much to the detriment of the plants. The writer estimates that a considerable loss of sugar results from the attendance of the Argentine ant on the sugar-cane mealybug.

NESTING HABITS.

Argentine ants are extremely social among their own kind, the individuals never having been observed to quarrel with one another, nor one colony with another. Workers may be carried for miles and placed with others of their kind and no apparent demonstrations of like or dislike are exhibited. The newcomers appear to enter into the colony spirit and are soon lost to the view of an observer. Any small nest will contain several queens which live together amicably.

The summer nest may be located anywhere—under sidewalks, under the sills of houses, in brick piles, stone piles, under a piece of board or a piece of tin, in an old tin can—in fact, in any place convenient to the food supply. In the winter months there is a tendency to concentrate into larger colonies, and they seek warm, dry, secure nesting places in which to hibernate. These desirable places are not plentiful, and where one is located the ants from some distance will seek its shelter. The winter is the most hazardous period of the year, for should a nest by any chance be flooded during a cold spell, when the ants are dormant, the chances of survival of the colony would be extremely slight. Usually throughout the latter part of December, January, and February (at New Orleans) these large colonies are found. They sometimes reach very extensive proportions and may contain several hundred queens and countless workers and immature stages. These colonies are usually located at the base of large trees on high, well-drained spots of ground, in manure piles, or in any other piles of decomposing rubbish where heat is generated. A warm day will make them particularly active, and they will form trails in all directions from these winter nests to food supplies. They may be observed traversing the trunks of trees every warm winter day, and from the trees trails are made to near-by houses, where they cause considerable annoyance.

With the advent of warm spring weather the breaking up of the large colonies occurs. This is the time of the year that food is very scarce, and at this season the ants are particularly aggressive and troublesome in the houses.

SCATTERED FROM TEXAS TO THE ATLANTIC, WITH INFESTATIONS IN CALIFORNIA.

Introduced years ago, probably on coffee ships landing at New Orleans from Brazil, the Argentine ant has been carried about the country in foodstuffs, until it now occurs in scattered localities throughout the South, the present northern limit being Nashville, Tenn. The farthest infestation in the East is Wilmington, N. C., while in the West it is found in several cities of central Texas, including Dallas, Fort Worth, and Houston. There is also a separate group of infestations in California.

HOW NEW TERRITORY IS GAINED.

Inspections indicate that when carried long distances the ants were more likely taken through on carload lots of foodstuffs which were rushed to their destination than along with smaller consignments. Arriving with the large shipments, they probably gained a foothold in the wholesale districts of such cities as Memphis and Atlanta, and from these centers were disseminated with small shipments to the surrounding towns.

There is also a normal extension of the territory occupied by the Argentine ant. This is 300 to 400 feet per year, and depends on the food supply and the abundance of other ants, the Argentine species waging a continuous warfare on native ants until the latter are entirely killed out.

To establish an infestation it should be noted that it is necessary for a gravid queen (egg-laying female) to be present. It is quite possible that into almost every town and city in the southern States there has been introduced at one time or another a number of workers, but as these are incapable of reproduction a colony has not become established.

THE NEST FLOODED, A COLONY MAY FORM A COMPACT BALL AND FLOAT AWAY.

Though the principal method of infesting new teritory is by rail, the Argentine ants are occasionally transported by high water. They are carried in lumber, rotting trees, uprooted shrubs, fruit, vegetables, etc., which may be swept from one location to another by a swollen stream. Even without such means of riding to safety, a flooded colony may not suffer extinction by drowning. The species has a remarkable habit of self-preservation in times of floods, for when rising water floods a nest, and no other way of escape is presented, the ants may cluster together and form a compact ball. The immature stages cluster at the center of this mass, while the queens and workers form the outer portion. As the ball enlarges by the addition of other workers which have been struggling alone in the water it gradually revolves. It is kept revolving slowly by the outside workers continually striving to reach the top of the ball, thus permitting air to reach the interior. The ants in these balls disperse when they come into contact with a secure resting place, but they may float about on still water for hours.

VARIOUS FORMS.

As with other ants, there are several distinct forms in a colony. The queen is a sexually perfect female, capable of depositing eggs. In one colony a number of queens may be present. The males or drones have apparently only the function of fertilizing the queens. The workers, foragers of the colony, are imperfect females with no reproductive functions. Besides these adult forms, there are usually eggs and other immature stages in a nest. (Fig. 1.)

CONTROL.

NATURAL CONTROL NOT EFFECTIVE.

Though sudden heavy rains, especially when combined with low temperatures in winter, reduce the numbers of the Argentine ant, it has been found that it is only a question of months before the normal infestation is regained. Other forms of natural control are of still less importance.

HOW TO KEEP ANTS FROM TREES.

Woglum and Neuls[1] recommend the following tree-banding mixture for keeping the ants from crawling up trees;

Finely powdered flowers of sulphur___________part by weight__	1
Commercial tree-banding sticky material______parts by weight__	6

The two ingredients are mixed together thoroughly with a wooden paddle until of a uniform color and consistency. The tree trunk should first be coated with melted paraffin, which will harden almost immediately. The mixture just referred to should then be applied over the paraffin in a band about 5 inches wide and about one-fourth inch thick.

---

[1] Woglum, R. S., and Neuls, J. D. The Common Mealybug and Its Control in California. U. S. Dept. Agr. Farmers' Bul. 862. 1917.

Before the band is applied the tree should be pruned so that the lowest branch is fully a foot above the ground, and all rubbish should be removed from beneath the tree and the soil cultivated to destroy all grass and weeds.

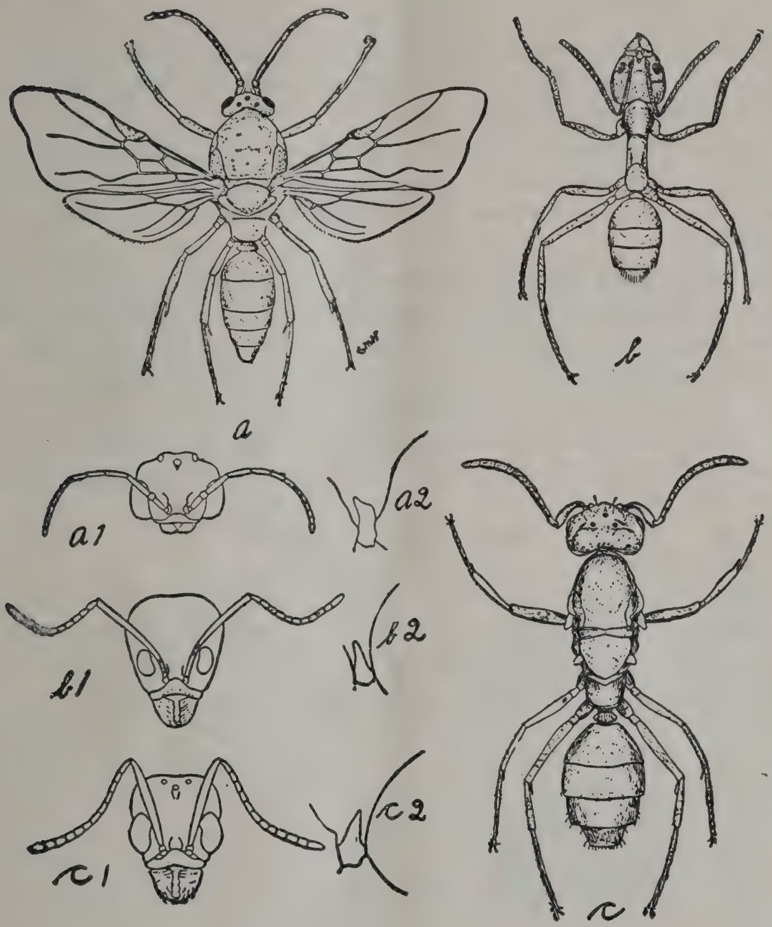


FIG. 1.—The Argentine ant, adult forms: *a*, Adult male; *a1*, head of male; *a2*, petiole of male; *b*, worker; *b1*, head of worker; *b2*, petiole of worker; *c*, fertile queen; *c1*, head of queen; *c2*, petiole of queen. All greatly enlarged. (Newell and Barber.)

HOW TO KEEP ANTS FROM TABLES, ETC., IN AN INFESTED HOUSE.

Perhaps the most effective and durable barrier which can be used indoors is a bichlorid-of-mercury tape or band. Tape is soaked in a saturated solution of bichlorid of mercury and then hung up to dry. It is then placed around the legs of tables, safes, etc., and if it is kept dry will last from six months to a year. Common lampwick one-half an inch wide is ideal for this purpose. After it has been treated in a saturated solution of bichlorid of mercury and dried, pieces are wrapped around the leg of the piece of furniture to be isolated and ends lapped over tightly and pinned. The tape can be readily renewed by another soaking in bichlorid of mercury and repinned in place.

Twenty-five per cent of bichlorid of mercury mixed in shellac may be painted around the legs of furniture, and when dry it will be quite as satisfactory as the tape.

Extreme caution is advised in handling bichlorid of mercury, as there is always an element of danger in using this poison. In recent years the sale of this drug to the layman has been practically discontinued.

A simple and efficient though perhaps unsightly barrier may be made by placing the legs of furniture in saucers and putting a generous supply of moth balls in each saucer. The moth balls will slowly volatilize, and it is necessary to add more from time to time, but the ants will not cross the barrier thus formed.

Coal oil placed in saucers in which the legs of furniture rest will repel the ant, but the odor of the oil is disagreeable to most persons.

STRONG ANT POISONS.

Many and varied experiments have proved that it is futile to try to exterminate Argentine ants with a poison which kills rapidly. A few workers may be killed, but the masses of ants will quickly recognize the source of fatality and avoid the "doctored" food. The few workers killed in this way will have no effect in reducing the numbers. None of this poison will reach the queens in the nest, and it has been found that it is essential to kill off the queens in order to prevent further multiplication of the pest.

Such poisons are, however, satisfactory for quickly ridding a house of ants, though the relief obtained is not permanent. Strong antimony or arsenical sirups, a number of which are sold by druggists in infested territory, are used for this purpose. They are usually placed about the infested house in small dishes, a few drops to a dish. Though the ants feed on such a sirup at first, they soon realize that it is harmful and vacate the building for a few weeks.

A SIRUP MADE ACCORDING TO A SPECIAL FORMULA MOST SATISFACTORY.

A weakly poisoned sirup, on the other hand, may be continually attended, the workers carrying it to the nest and feeding it to the queen and the larvæ, eventually exterminating the entire colony. A special poisoned sirup[1] has been devised. It is prepared as follows:

Granulated sugar	pounds	9
Water	pints	9
Tartaric acid (crystallized)	grams	6
Benzoate of soda	grams	8.4
Boil slowly for 30 minutes. Allow to cool.		
Dissolve sodium arsenite (C. P.)	grams	15
In hot water	pint	½
Cool. Add poison solution to sirup and stir well. Add to the poisoned sirup:		
Honey	pounds	1¼
Mix thoroughly.		

APPLICATION OF THE SIRUP.

On account of the ants continuing to feed on a weakly poisoned sirup, it is desirable to place it in cans or paraffined paper bags *outside* of the infested house. The ants will be attracted away from the house by the sirup on the outside, not temporarily driven away through fear as they are by a strongly poisoned sirup within the house. Within a day or so after the sirup is put out no ants should be found in the house.

It may happen from time to time that some of the cans will be found deserted. This is often because the ants are attracted by other food, especially the honeydew given off by aphids and mealybugs. During the middle of the summer it is very hard to attract them away from this honeydew, which is their natural food, and for this reason it is desirable to poison them during the cooler months of the year, especially during early spring, when there are fewer insects to supply them with a food substance which is more attractive than the purest sirup. Houses, however, may be freed from ants during midsummer by the use of the sirup made according to the formula given above.

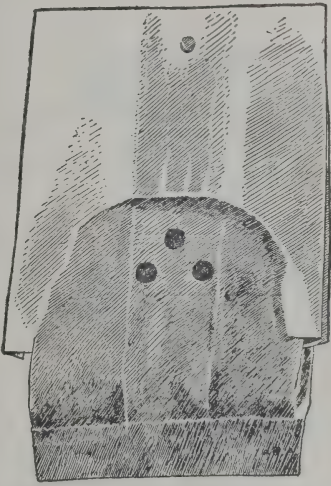


FIG. 2.—Paraffined paper bags arranged as a container for ant-poison sirup. The apron has been cut away to show entrance holes. Such bags are nailed to trees.

The paraffin-covered paper bag shown in figure 2 is undoubtedly the cheapest container. It can be made in large quantities at a cost of about $5 per thousand. Small 1-pound bags used in grocery stores are obtained, and two or three holes about one-fourth inch in diameter are cut through each folded bag with a leather-punch or similar instrument. This provides each bag with two or three holes on each side for the entrance of the ants. Being opened, the bags are dipped in a pan of molten paraffin and set aside to dry. The paraffin, forming a waterproof surface, materially lengthens the life of the bag, which is protected from the entrance of water through the holes by part of another (2-pound) paraffined bag which covers the first one like a canopy. In use, each bag is provided with a small quantity of poisoned sirup and a piece of sponge, the protecting outer piece of bag is drawn over it, and the ends of both are folded over at the top and tacked to a tree. On account of the bag coming together at the top it is very narrow at the point where the entrance holes are made; consequently very small pieces of sponge are required. The bags have been known to last for long periods, but the larger percentage of them last only about two or three months. They can not be recharged.

---

[1] Accuracy in the use of the specified ingredients and weights is necessary if successful results are to be secured.

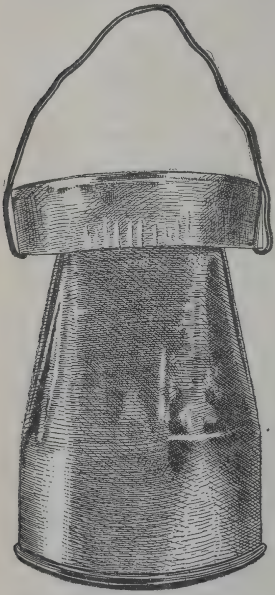


FIG. 3.—Tin can container for ant-poison sirups used in outdoor experiment.

The tin can snown in figure 3 is the most satisfactory container. Any sized can may be used, but the handiest size is the one-half pound baking-powder can. The can must have a friction cover, and of course it must hold water. If the can is indented deeply on the two opposite sides (as illustrated in the drawing, fig. 3) and the cover replaced, it will be observable that there is ample space between the top of the can and the cover for the entrance of the ants, and the can, if kept in an upright position, will be weatherproof. About a gill of the sirup will be sufficient for several months, but in heavy infestations it is better to put 2 gills in each can. It is very advisable to place a fairly large piece of sponge in the can. The sponge will float on the sirup and allow the ants to feed in large numbers. A piece of wire about 6 inches long may be bent for a handle, a hook inward at each end being made. The hooks may be attached under the lid of the can where it projects over the part that has been indented. This forms a handle by which the cans may be hung on trees, fences, walls of houses, etc. The ants prefer to climb for their food, and it is well to hang the cans near ant trails going up trees, walls, etc. It is advisable to hang the cans in the shade to prevent the evaporation of the sirup, for though it has been proved that evaporation does not affect this sirup to a marked extent, it is well to avoid raising the solid contents of the liquid. Eight to ten of these cans should be sufficient to place around an ordinary city house and lot. If the grounds are large and if many trees are present, more cans should be placed out.

From the results so far obtained, the careful preparation of the poisoned sirup can not be too highly emphasized. Very accurate balances are necessary for the weighing out of the poison and the tartaric acid. This is especially true when small quantities of the sirup are prepared.

PLANS FOR MUNICIPAL CONTROL WORK.

In effecting control in towns and cities it is first necessary to ascertain the extent of the infestation. This should be mapped out so that workmen in distributing the cans will be able to refer to the map to insure the covering of the entire territory. Cans may be obtained at wholesale at about $16 per thousand.[1] About 10 pounds of "grass" sponges will be required per 1,000 cans. These will cost about 75 cents per pound. The sponges should be thoroughly washed and dried before use. When wet they may be easily torn into pieces about 2 by 2 inches. Using 1 gill of sirup per can, 200 pounds of granulated sugar will be required per 1,000 cans. The cost of the sodium arsenite is about 80 cents per pound, and 1 pound will be sufficient for 1,500 cans. Tartaric acid (crystallized) costs about 70 cents a pound, which will be enough for 4,500 cans. From 60 to 100 cans will be required per block, depending on the size of the block. The late fall, winter, and spring are the most desirable times in which to do this work, as in these seasons the natural food is least plentiful and the ants most hungry. Two men should be able to prepare the sirup, wash and tear up the sponges, and charge about 2,000 cans per day and distribute about 1,000 cans per day.

TRAPPING ANTS.

By taking advantage of their winter colonizing habits the ants may be attracted in large numbers to specially prepared trap boxes, which may be fumigated when large numbers have gathered in these boxes for winter nesting. The boxes should be filled with decaying vegetation, the heat generated making them very attractive as hibernating quarters. Carbon disulphid was found to be the best and most economical fumigant for use in the trap boxes. It is hardly necessary to state that this method of control is not applicable to city conditions, where dry nesting quarters are very plentiful and the ants do not colonize to any great extent.

---

[1] The cost figures given in this paragraph are approximately normal. Present war prices are probably higher for each item.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

Farmers' Bulletin 1102 United States Department of Agriculture

THE CROW IN ITS RELATION TO AGRICULTURE

Is It a Farm Pest?

THE CROW is best known by the unfavorable reputation it has acquired in the cornfield. Notorious also are its raids on the poultry yard, its depredations on wild birds, and its attacks on crops other than corn.

Less heralded, however, but no less important to the farmer, is the crow's warfare on insect pests. Insects supply about one-fifth of its food, and those preyed upon include some of the worst pests with which the farmer has to contend—grasshoppers, caterpillars, and white grubs and their parents, May beetles.

From the evidence at hand the crow's merits and shortcomings appear about equally divided. While it would be unwise to give it absolute protection, and thus afford the farmer no recourse when the bird is doing damage, it would be equally unwise to adopt the policy of killing every crow that comes within gunshot.

Much of the good the crow does can ill be spared, and the damage it inflicts may be materially lessened by proper measures against such birds as prove to be a nuisance.

Show this bulletin to a neighbor. Additional copies may be obtained free from the Division of Publications, United States Department of Agriculture.

Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief
Washington, D. C. August, 1920

THE CROW IN ITS RELATION TO AGRICULTURE.

E. R. KALMBACH, *Assistant Biologist.*

CONTENTS.

	Page.
Distribution and abundance	4
Life history	5
Economic status	7
Animal food	7
Insects	7
Spiders, fishes, reptiles, etc	10
Wild birds and their eggs	10
Poultry and their eggs	10
Mammals	11
Carrion and the distribution of live-stock diseases	11
Vegetable food	11
Corn	11
Other grains	12
Economic status—Continued.	
Vegetable food—Continued.	
Other crops	12
Wild fruits	13
Distribution of seeds	13
Summary of food habits	13
Protection of crops and poultry	15
Frightening devices	15
Deterrents	16
Scattering grain	17
Poisoning	17
Trapping	19
Shooting	19
Destroying nests	19
Summary	19

IT IS DOUBTFUL whether any other bird is of as great economic importance to the farmer of the eastern United States as the crow. In food habits it is practically omnivorous; it takes anything from the choicest poultry and the tenderest shoots of sprouting grain to carrion and weed seeds, many of which offer at best but a morsel of nourishment. The fact that no less than 656 different items have been identified in its food gives some idea of the bird's resourcefulness and its potentiality for good or harm. Some of the complaints against the crow are well-nigh traditional, while a few of its beneficial habits have long been matters of common knowledge. Irreconcilable differences of opinion regarding the crow's worth have often been the rule among residents of a community, and it has been only recently that sufficient information has been assembled from most parts of the bird's range to allow a thorough study of its habits.[1]

---

[1] For a comprehensive treatise on the economic status of the crow based on the examination of the food contained in 2,118 stomachs, see Bulletin No. 621, U. S. Dept. Agr., "The Crow and Its Relation to Man," by E. R. Kalmbach, 92 pp., 2 pls., 3 figs., Feb. 16, 1918.

DISTRIBUTION AND ABUNDANCE.

Although the crow is so well known to farmers in the Eastern States that one would hardly suppose it could be confused with other birds, considerable uncertainty in identification exists in regions where it is scarce or where its range overlaps that of closely related species. Ordinarily little distinction is made by the residents of the South Atlantic coast between the common crow and the fish crow—a bird of quite different habits; and the same lack of distinction is shown by the average individual of the northwest coast, where the northwestern crow, also a maritime species, mingles with the common form. In the Southwest the small white-necked raven is frequently called a crow, and in some other parts of the West even the larger ravens have been similarly misnamed.

There are within the borders of the United States three species of crows. By far the most abundant and widely distributed form is the common crow.[1] This bird, with its three closely related varieties, the Florida crow,[2] the southern crow,[3] and the western crow,[4] occupies a range comprising practically all of our country east of the Rocky Mountains, as well as sections in the Northwest and along our western coast as far as southern California. It also is found locally in parts of Arizona and New Mexico. The other two species are smaller and of maritime habits. The fish crow,[5] whose notes are not greatly different from those of the young of the common crow, occupies a narrow strip along the Atlantic and Gulf coasts from Connecticut to Texas, and is seldom found more than twenty miles from salt water. Its counterpart, the northwestern crow,[6] which some authorities consider simply a subspecific form of the common crow, occupies the Pacific coastal region from Puget Sound to southern Alaska.

The white-necked raven,[7] inhabiting the arid and semiarid sections of Texas and southern New Mexico and Arizona, is the raven most frequently confused with the crow. This bird's slightly greater size, the white bases of the feathers of its neck, and its restricted range, however, serve to identify it. The northern raven,[8] found along our northern boundary and at higher altitudes farther south and the common raven,[9] present in numbers in the States west o the Great Plains, may be distinguished by their greater size and b their discordant notes, which possess none of the lusty, open-throate quality of those of the crow.

In this bulletin the name "crow" has been used to cover the fou forms of the common crow, including the close relatives, the Florida southern, and western crows.[10] The food habits of all these are es entially the same, differing only to an extent occasioned by the varyng character of the food supply in the different parts of the area covered by their combined ranges. In some of the Western States, where the crow appears only as an occasional breeder, it has little economic significance, as in Nevada and the greater parts of Arizona, New Mexico, Colorado, Wyoming, Utah, Idaho, and parts of Washngton and Oregon. It can be considered only locally abundant in California. The western parts of Texas, Oklahoma, Kansas, and Nebraska support very few crows; and in large areas of Montana, North Dakota, and South Dakota, and in the Gulf States of Florida, Alabama, Mississippi, and Louisiana crows are not common. Based on the average yearly abundance, the crow exerts its greatest economic influence in the States along the Atlantic coast north of North Carolina and in the central and upper Mississippi Valley.

---

[1] *Corvus brachyrhynchos brachyrhynchos.*

[2] *Corvus brachyrhynchos pascuus.*

[3] *Corvus brachyrhynchos paulus.*

[4] *Corvus brachyrhynchos hesperis.*

[5] *Corvus ossifragus.*

[6] *Corvus caurinus.*

[7] *Corvus cryptoleucus.*

[8] *Corvus corax principalis.*

[9] *Corvus corax sinuatus.*

[10] *Corvus brachyrhynchos*, four subspecies.

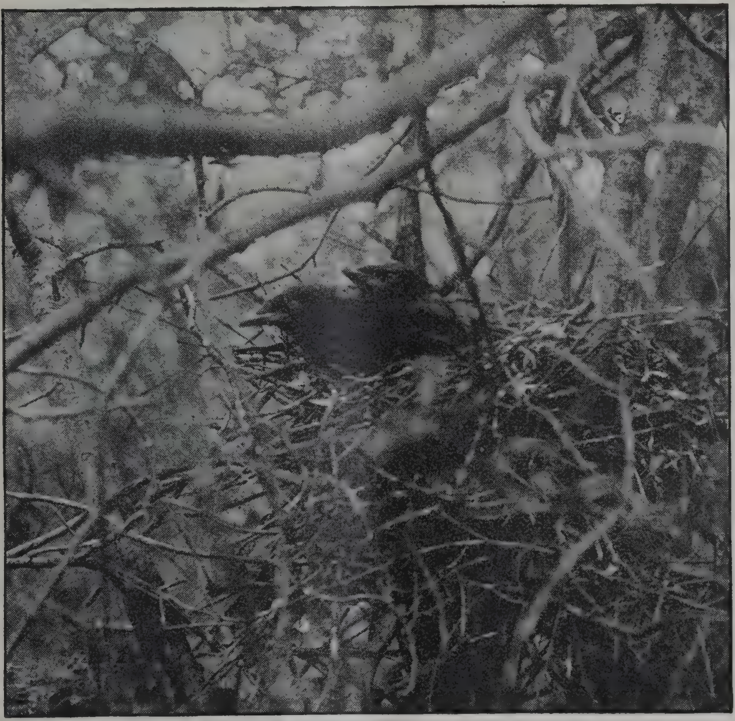


FIG. 1.—Young crows nearly ready to leave the nest.

LIFE HISTORY.

The nest of the crow is built at heights varying from 20 to 60 feet, and during the breeding season it is usually well concealed from below by foliage. Sometimes it is placed in the dense top of a pine, but oaks and elms of the river bottoms, and, in the West, cottonwoods are equally acceptable. The nests are rarely found in deep forests. In the East the hilly and partially wooded sections of New Jersey, New York, and Pennsylvania seem to meet nesting requirements; in Ohio, Indiana, and Illinois the low fertile river bottoms are especially attractive; and farther west the limited tree growth confines the breeding activities of crows to the neighborhood of streams.

Crows raise one brood of from 3 to 7 young (see fig. 1). In the Southern States the young may be found in the nest as early as the middle of March and farther north correspondingly later, so that along our northern border they may be present as late as July. The nestling life lasts about three weeks. For some time after the brood of the year has left the nest, in July, August, and September, crows may be found in family parties or in small, loose flocks of 10 or a dozen, securing much of their food from grasshoppers and ripening corn.

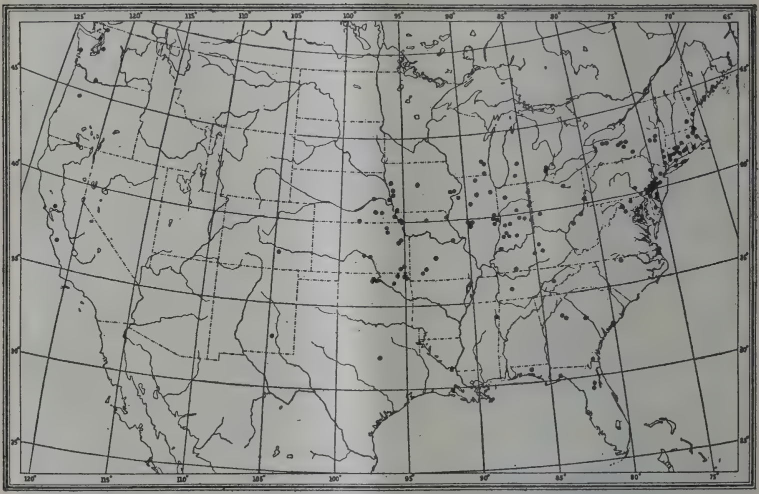


FIG. 2.—Location of crow roosts known to have been occupied in the winter of 1911–12.

While crows are more or less clannish, even in the nesting season, their gregarious habit is most highly developed during the colder months, when, often by thousands, they resort to their nightly roosts. This flocking is of considerable economic significance in that it results in the gathering together of large numbers of birds possessing some injurious habits. In the latitude of Washington, D. C., their roosts are well established by the end of September, and by midwinter their combined southerly migration and gregarious habits have brought together in a comparatively small area the bulk of the crow population of North America. From October to March the States lying in the area between Connecticut and Iowa and south to

Virginia and Oklahoma harbor crows in extremely large numbers, and damage often results in places where crops are left in the fields until late in fall. On the accompanying map (fig. 2) are recorded crow roosts known to have been occupied in the winter of 1911–12.

ECONOMIC STATUS.

What a bird eats or does not eat is the first question to be answered in an inquiry into its economic status. To determine with accuracy the various items entering into its diet nothing has been found more reliable than the examination of stomach contents. In the case of the crow such examination has been made of an excellent series of 2,118 stomachs, collected in 40 States, the District of Columbia, and several Canadian Provinces. Of these stomachs 1,340 were of adult crows and 778 of nestlings.

ANIMAL FOOD.

About 28 per cent of the yearly food of the adult crow consists of animal matter. In this are found insects, spiders, millipeds, crustaceans, snails, the remains of reptiles, amphibians, wild birds and their eggs, poultry and their eggs, small mammals, and carrion.

Insects.

Over two-thirds of the animal food, or about a fifth of the whole diet of the crow, is composed of insects, and these include many of the most destructive pests with which the farmer has to deal. The crow is primarily a terrestrial feeder. Its share of insects, therefore, is made up almost exclusively of species found on or near the ground, or those which it secures from beneath the surface by turning over sticks, clods of earth, or dung. The latter is a common method of feeding employed diligently by the crow from early spring to the beginning of autumn, when the usual crop of grasshoppers furnishes a more accessible supply of food.

Beetles of various kinds constitute about 7.5 per cent of the crow's annual food. They are a promiscuous lot, some beneficial, some neutral, and others, which comprise the major portion, highly injurious. Among the injurious are May beetles and their larvæ, white grubs; also click beetles, weevils, and some of the ground beetles which have vegetarian food habits. Orthoptera, including grasshoppers, locusts, and crickets, form about an equal quantity (7.33 per cent), but the damage this order of insects inflicts far exceeds that done by the various beetles eaten. The short-horned grasshoppers especially are destructive, and, while these insects have never been such serious pests in the Eastern States as in some parts of the West, the annual toll taken by them throughout the country amounts to many millions of dollars. In August and September grasshoppers form

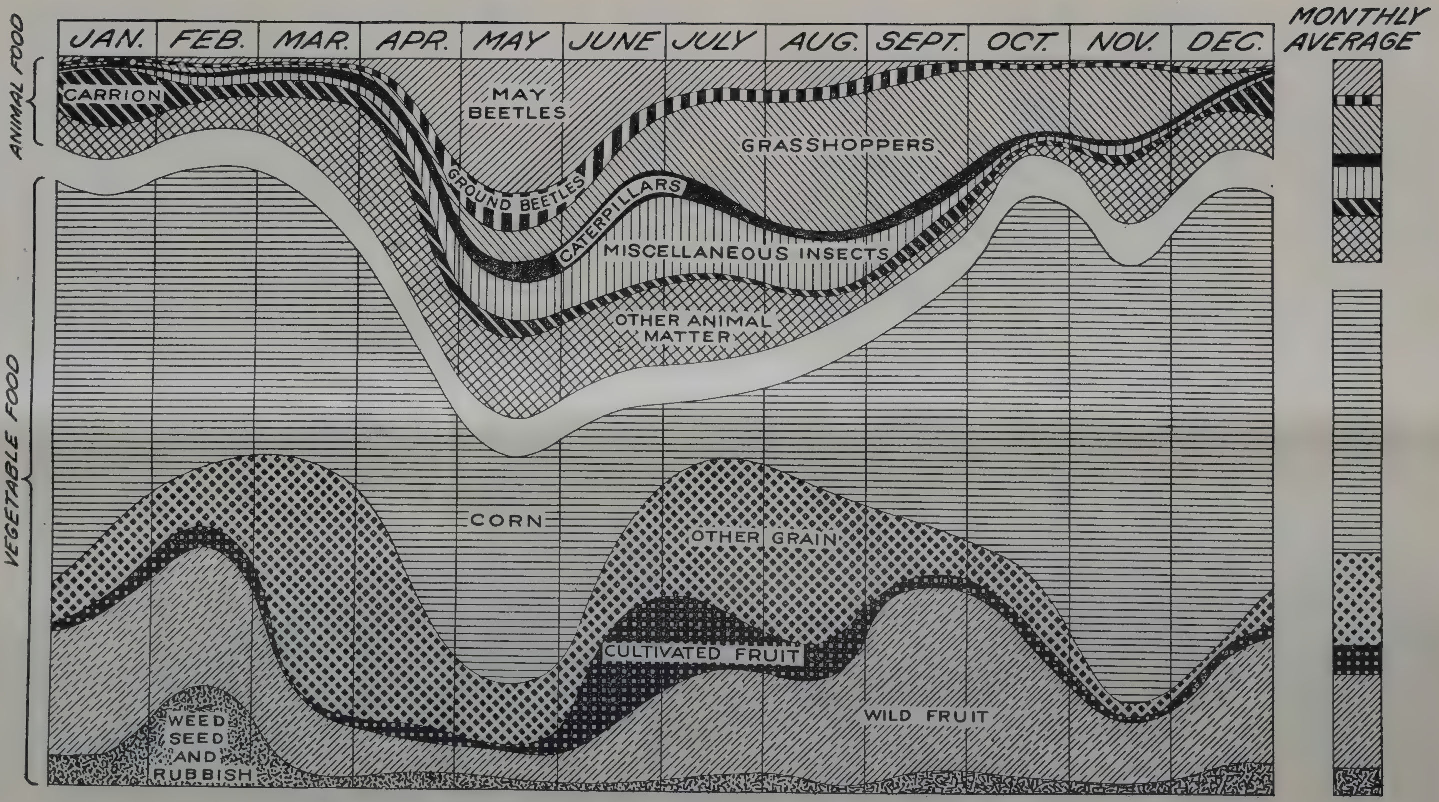


FIG. 3.—Food of adult crows. Showing the varying quantities of the principal items from month to month, and the relative monthly average of each item. In Table I is presented the same information in percentages.

nearly one-fifth of the crow's food. Caterpillars form about 1.5 per cent of the diet of the adults; nestlings, however, eat nearly four times as much. Other insects, as bees, wasps, ants, flies, and true bugs, are taken in only small quantities, and the economic problems involved are not important.

The numbers of the various insects eaten during different months of the year are often indicative of their period of abundance. Early in spring, for instance, few May beetles or other scarabæid beetles are eaten; but, beginning in April, they form about 5 per cent of the crow's food, and in May the presence of the annual crop of May beetles is indicated by the extraordinary percentage of 20.99. Likewise the monthly increase of grasshoppers from May to September is shown in the crow's diet by the approximate percentages of 4, 6, 14, 19, and 19, representing the proportion of these in the food taken. The height of the caterpillar season also is indicated by the approximate percentages of 1, 3, 6, and 2, for the months of April, May, June, and July, respectively.

TABLE I.—*Monthly percentages of the principal food items of the adult crow.*

Kind of food.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
May beetles, etc	0.18	1.19	1.04	4.98	20.79	10.06	4.47	5.26	0.91	0.54	0.77	1.17	4.28
Ground beetles	.07	.10	.26	2.30	5.54	3.24	2.13	1.76	2.31	.14	.74	.19	1.56
Grasshoppers	.51	1.14	.56	1.84	4.29	5.83	14.04	19.14	19.24	8.68	10.73	2.07	7.34
Caterpillars	.18	.41	1.36	1.13	2.71	6.41	1.95	.62	2.12	1.19	.30	.39	1.56
Miscellaneous insects	.35	2.01	1.36	4.47	6.44	10.41	11.26	8.29	3.06	.96	1.62	.67	4.23
Carrion	8.95	2.45	2.66	5.24	2.13	1.48	.29	.95	2.69	.32	1.44	2.37	2.58
Other miscellaneous animal matter	4.70	3.67	8.81	14.13	10.56	9.55	10.14	3.38	1.99	2.46	3.14	6.32	6.57
Corn	51.95	43.19	36.85	35.28	33.26	20.53	9.13	17.96	29.60	54.33	63.93	65.00	38.42
Other grain	7.00	9.74	34.22	20.90	8.43	10.20	20.22	22.80	8.33	7.08	2.67	.89	12.70
Cultivated fruit	2.55	3.42	.26	2.74	.91	14.12	9.31	5.79	1.66	2.40	.07	1.36	3.74
Wild fruit	19.76	19.57	10.65	5.06	3.49	7.28	14.05	13.67	25.82	20.50	12.94	14.75	13.96
Weed seeds and rubbish	3.80	13.11	1.97	1.93	1.45	.89	3.01	.38	2.27	1.40	1.65	4.82	3.06

The size and the voracious appetites of crows make these birds especially valuable in times of outbreak of one or another of the insect pests upon which they feed. In the stomach of a crow collected in April were the remains of 85 May beetles, and these formed less than half the food; in another were 72 wireworms; and in a third were fragments of 123 grasshoppers. Twelve birds in a series collected in Manitoba had fed on grasshoppers at the average rate of 57 each, and one crow secured in Michigan had eaten 483 small caterpillars. Nestling crows, whose rapidly growing bodies require even greater quantities of insect food than the adults, often excel their parents in the good work of insect destruction. One brood of 4 had consumed 418 grasshoppers, and another brood of 7 had made away with 585 during a few hours before they were collected. Of a total of 157 nestling crows secured in Kansas in 1913, 151 had been fed on grasshoppers. Caterpillars, always a favorite source of food for nestling birds, were present in over a third of the 778 nestling-crow stomachs examined.

Summing up, it may be said that the character of the insect food of the crow leaves little to be desired and becomes the strongest argument in the bird's favor. While fully applicable to the adult birds, this statement is doubly true of the nestlings, whose rapidly growing bodies require enormous quantities of such readily digestible food as is furnished by soft-bodied insects.

SPIDERS, FISHES, REPTILES, ETC.

In the other animal food of the crow are items that reflect some of the bird's less-admired habits. The aggregate consumption of spiders, millipeds, crustaceans, mollusks, fishes, and carrion may be considered as having a slight influence for good, but the destruction of beneficial toads, frogs, and small snakes is against the bird. Fortunately, however, the quantity of such material eaten is small, slightly more than 1 per cent of the yearly food.

WILD BIRDS AND THEIR EGGS.

Because of its depredations on small wild birds and its destruction of the nests and eggs of larger game species, the crow has received the condemnation of bird lovers and sportsmen. While stomach examination has, to an extent, verified this accusation, it has at the same time disproved extravagant statements. About a third of 1 per cent of the annual food of adult crows and 1.5 per cent of that of nestlings is derived from wild birds and their eggs, and about 1 in every 28 adult crows and 1 in every 11 nestlings examined had eaten such food. In the case of the nestlings, however, this ratio gives an exaggerated idea of the work done, as in many instances several members of a brood had fed on parts of the same victim. A mitigating circumstance in connection with the destruction of the eggs of wild birds lies in the fact that most of it is done during the nesting season of the crow—a time early enough in the year to allow the species attacked to lay a second set of eggs that will be little molested by crows. Nevertheless, on game farms and preserves, and in suburban districts where it is the desire to foster small birds, the crow population must be held in check.

POULTRY AND THEIR EGGS.

The crow's depredations on poultry and their eggs are governed largely by local conditions. The proximity of a crow's nest containing a brood of voracious young, the accessibility of some particular poultry yard, and the overdevelopment in certain individual crows of this obnoxious habit, are factors accountable for most of the losses to poultry raisers from crows. Reports of striking similarity often come from localities widely separated, while circumstances diametrically opposite have been reported from neighboring farms. Food of this sort forms an extremely small part of the annual diet of the crow, less than 1 per cent (0.57) of the adult's and 1.6 per cent of the nestling's. As in feeding on wild birds, the crow's visits to the poultry yard are most frequent during the period when it has young to feed; as a consequence, successful protective measures undertaken in May, June, and July will reduce to a minimum the crow's depredations on poultry.

MAMMALS.

In feeding on mammals the crow supplements the good work of hawks and owls by tending to hold in check rodent pests. Such food forms 1.6 per cent of the diet of adult crows and 8.8 per cent of nestlings. Their favorite mammal food consists of young cottontail rabbits. While the crow does molest such live stock as young lambs and swine, this is only an occasional habit when the bird is hard pressed for food. Fortunately such work is not common and the aggregate loss of this kind is negligible.

CARRION AND THE DISTRIBUTION OF LIVE-STOCK DISEASES.

As a carrion feeder the crow ably supplements the good work of the turkey buzzard, especially along river banks and tidal flats, where dead fish furnish a supply of animal matter much needed during winter. But, from its carrion-feeding habits, the crow has been accused of being a potent agency in the transmission of live-stock diseases, especially hog cholera. No doubt the transmission of this disease by the crow is within the range of possibilities, either by the carrying of virus attached to its feet, bill, or other parts of its body or possibly by the depositing of infected excreta after the bird had fed on the body of an animal that had died from the disease. However, by the immediate burying of the dead bodies of diseased animals and the employment of rigid sanitary measures in outbreaks of this kind, the incentives which usually attract these birds may be eliminated. It is well to add that many other agents in the spread of such diseases, including dogs, cats, and innumerable insects, are as potent in the dissemination of bacteria as are crows. All of these can be made innocuous by thorough methods of sanitation, while the extermination of the crow would eliminate only one of many means by which such diseases are transferred.

VEGETABLE FOOD.

CORN.

Vegetable matter forms nearly 72 per cent of the adult crow's yearly food, and over half of it consists of corn. In November, December, and January this grain forms over half the diet, but most of it is waste, gleaned from scattered unharvested ears. During the sprouting season of April and May, corn constitutes about a third of the food, and at the harvest in October it again supplies over half. Of 1,340 adult crows collected in varying numbers in every month of the year, 824 (over 61 per cent) had fed on corn.

It is the belief of some farmers that the depredations on this grain in sprouting time are due largely to the nestlings' desire for the soft, germinating kernel. Stomach analysis has disproved this, and has showed that corn formed less than an eighth of the young crow's food, one-third the quantity taken by the adults during approximately the same time. Injury to this crop may be either to sprouting corn, to corn "in the milk" or in the "roasting-ear" stage, or when the ripened grain has been stacked in shocks. Of the three, the last form of injury is the least serious; the pulling of sprouting corn sometimes results in heavy losses, but fortunately such damage may be reduced by the use of deterrents; the damage to corn in the roasting ear is the most vexatious form of damage to this grain of which the crow is guilty. It is not so much the corn the crow actually eats at this time, as it is the subsequent injury resulting from water entering the ears from which the husks have been partially torn, that makes such attacks among the most serious with which the farmer has to contend.

OTHER GRAINS.

Of the smaller grains, which together form about an eighth of the food of the adult crow, wheat is the favorite. This was present in 227 of the 1,340 stomachs examined, and it apparently takes the place of corn in the crow's diet in regions where corn is not raised extensively. Stomachs collected in the Northwest illustrate this. When attacks upon wheat are made in sowing or sprouting time, the depredations of a single crow, limited only by a most ample gizzard, may be of considerable consequence. Oats are eaten much less frequently than wheat, and when it is considered that oats are readily available at all times of the year in horse droppings, the quantity of this grain in the diet of the crow need not much concern the farmer. Injury to kafir corn (sorghum) in autumn has been reported from Kansas and Oklahoma, usually in the vicinity of roosts, where many thousands of crows congregate and feed over a comparatively small area day after day during fall and winter. Buckwheat also is occasionally eaten, but by far the largest portion of it is waste.

OTHER CROPS.

A number of other crops are subject to damage by crows. In Southern States, depredations on ripening watermelons have sometimes resulted in heavy losses. Apples, peanuts, pecans, and almonds are less frequently injured; while the aggregate losses to such crops as beans, peas, figs, oranges, grapes, and cherries are insignificant.

WILD FRUITS.

Only about 14 per cent of the adult crow's sustenance is at present derived from wild fruits and nuts, a source whence it originally obtained all of its vegetable food. This part of its diet is secured from a variety of sources, but chiefly from acorns and chestnuts. Fruit of the various sumachs, poison ivy and poison oak, bayberry, dogwood, sour gum, wild cherries, grapes, Virginia creeper, and pokeberry are also common ingredients in the food.

DISTRIBUTION OF SEEDS.

The mere consumption of wild fruit by the crow involves nothing of economic importance, but as its digestive processes destroy practically none of the embryos of the seeds, the bird acts as an important distributor of certain noxious plants, as poison ivy and poison oak. In this work, however, it is only supplementing the activities of the many other native birds which feed on these seeds, often to a greater extent than does the crow. Furthermore, as most of these seeds are eaten by the crow during the winter, a large part of those regurgitated are deposited at their roosts, often in dense stands of timber, where the chances for sprouting are poor.

TABLE II.—*Percentages of the principal food items of the nestling crow.*

May beetles.	Ground beetles.	Other beetles.	Grasshoppers.	Bugs.	Caterpillars.	Miscellaneous insects.	Spiders and myriapods.	Crawfish.	Fish and mollusks.	Amphibians and reptiles	Wild birds and eggs.	Poultry and eggs.	Rodents.	Other mammals.	Carrion.	Corn.	Miscellaneous vegetable matter.
17.44	3.90	2.59	14.60	2.61	5.34	1.88	9.68	1.78	0.68	7.04	1.57	1.60	6.22	2.61	3.95	11.91	4.58

SUMMARY OF FOOD HABITS.

The crow's consumption of insects presents the strongest argument in the bird's favor. About a fifth of its diet is secured from the insect world, and among the pests it destroys are some of the most troublesome with which the farmer has to contend. Many of the insects it eats are taken early in spring, when their life cycles are at the lowest ebb and when their destruction results in the greatest good.

Conspicuous among such food items are May beetles and their destructive larvæ, white grubs, of which the crow is an effective enemy. In its consumption of grasshoppers the crow probably renders man its greatest individual service, and in regions where these insects are abundant their nymphs form the principal insect food of the nestlings. Other creatures in the destruction of which the young exceed the adults include caterpillars and spiders. The latter, however, are predacious and to a great extent beneficial.

The crow's feeding on reptiles and amphibians is on the whole not to the best interests of man, but fortunately the highly beneficial toads are found in the food less frequently than the more aquatic frogs and salamanders. In feeding on the eggs and young of small insectivorous and game birds the crow commits a serious offense, and in the vicinity of game farms and preserves the bird must be held in check if other species are to exist in concentrated numbers. This offense is mitigated somewhat by the fact that most of the depredations on eggs occur early enough in the season to permit the raising of a second brood at a time when there is little or no danger from the crow. The molesting of poultry is an injurious habit against which protective measures are effective under any but the shift-by-

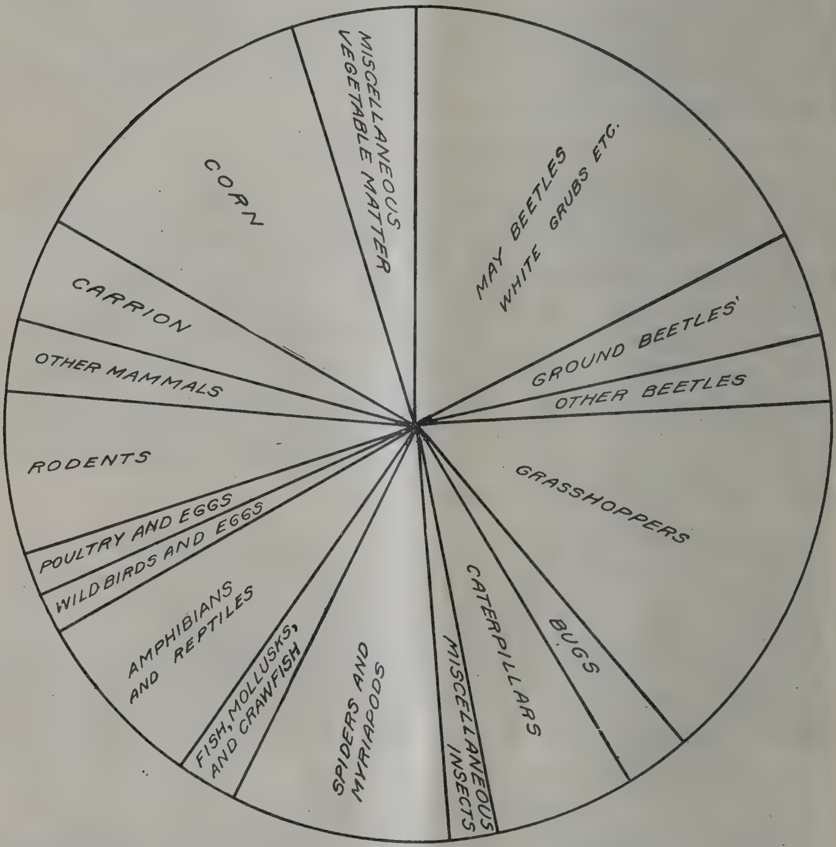


FIG. 4.—Food of nestling crows. The proportions of the various elements are represented by the relative sizes of the sectors. In Table II the same information is presented in percentages.

itself method of caring for fowls. A little attention to the screening of young chicks and the suitable housing of setting hens will obviate most losses of this kind. In its feeding on small mammals, its annoyance of young live stock, and its consumption of carrion, the crow has tendencies about equally divided between good and bad. The accusation that it is a dominant factor in the distribution of live-stock diseases has little substantiating evidence.

Of the vegetable food, corn is the principal item. It is the crow's staff of life and furnishes over 38 per cent of its annual sustenance. In the consumption of this grain the bird comes in most frequent conflict with the farmer. Much of the corn eaten, however, is secured from October to March, when waste grain necessarily forms a large part of the supply. Deterrents, as coal tar, on the seed have lessened losses to sprouting grain, especially in small isolated fields, but, when "in the roasting ear," the corn crop is subject to annoying and destructive attacks by the crow, difficult to prevent. The crow also levies a certain toll on small grains, as wheat and sorghums; melons are subject to attack and even cultivated fruits at times are damaged.

The offenses of which the crow has been accused outnumber its good deeds, but this does not mean that they are equal in importance. Many of the crow's depredations may be lessened or entirely prevented by protective measures, while in its preying on insects it does work that can ill be spared. An overabundance of these birds is not to the best interests of the farmer, but, on the other hand, extermination of the crow would result in taking away a most effective enemy of certain insect pests. Consequently the instituting of control measures is justifiable locally where the birds are taking more than a fair share of the crops in return for good services rendered, while in other sections where crows occur in normal numbers they may better be allowed to exist unmolested.

PROTECTION OF CROPS AND POULTRY.

FRIGHTENING DEVICES.

It is not necessary to describe in detail the many well-known devices employed as "scarecrows." The time-honored straw-stuffed human effigy is the one most frequently used, though often it fails to accomplish its purpose. Various unusual objects, as pieces of shining tin moving in the wind or glass bottles hung about fields, windmills operating a noise-producing mechanism, newspapers placed on the ground, twine stretched about and across fields from poles stationed at intervals around them, as well as bodies of dead crows hung in conspicuous places, have been successful in some instances. Poultry yards especially have been protected from the ravages of crows by strands of cord stretched across at intervals and at a height of 6 or 8 feet from the ground. One or another of these methods has met with varying success on occasion, but sometimes none will produce the desired results. None can be considered infallible.

DETERRENTS.

Coal tar.—Experience has shown that damage to corn and other grains at sprouting time may be lessened by special treatment of the seed. While the application of deterrents to the seed grain has disadvantages, in that it involves additional labor at planting time, tends to retard germination in periods of dry weather, and can not be considered an absolute cure, the measure of success of many farmers who have in this manner secured relief from crow depredations warrants a description of the methods used.

One of the most successful deterrents is coal tar, a cheap by-product in the manufacture of illuminating gas, which may be secured at gas works or at some paint shops. It is a dark, heavy liquid of about the consistency of thin molasses and emits a strong, gassy smell for some time, even after the grain treated with it has become thoroughly dry. When used in the quantities here recommended, coal tar in no way injures the germinating qualities of the seed. This important qualification is not possessed by certain other substances, sometimes recommended as crow deterrents. Experiments conducted by the writer also have shown that in periods of normal rainfall germination is but slightly retarded by the coal-tar treatment, though in periods of drought the retardation may be several days.

Coal tar should be used in the proportion of about a tablespoonful to half a bushel of seed grain, the grain having been previously heated by the application of warm water, and then drained. A continued stirring of the grain will eventually result in an even coating of tar. The seed may then be spread out on a dry surface or may be dried by the application of an absorbent medium, as ashes, land plaster, or powdered earth. When thoroughly dry it may be used in a planter.

Deterrents are commonly used by farmers of the North Atlantic States and to a lesser extent by farmers of the South Atlantic States. In the extensive corn-raising regions of Illinois, Missouri, and Iowa, corn is seldom tarred, probably because it is planted on so large a scale that losses to the individual farmer are less severe.

Red lead.—Another substance used as a deterrent is red lead. This appears to have been used first in Europe, where it met with considerable success. The grain is first given a thin glue size, and is then drained and dusted with red lead until well colored. Though this process has been used but little in this country, its success in deterring birds in Europe warrants a further trial here.

Other deterrents.—A few years ago the Kansas State Agricultural College Experiment Station conducted a series of experiments on seed grain to ascertain the usefulness of certain deterrents against burrowing animals. Incidentally the effect of these various substances upon the germinating powers of the seed was investigated. In his report on this work, Theo. H. Scheffer[1] says in part that kerosene, crude petroleum, copperas, crude carbolic acid, fish oil, and spirits of camphor, when used in sufficient quantity or strength to impart an odor to the corn, seriously injure the germinating powers of the grain; and that to treat the seed with any of these substances in such small quantity or dilute form as not to injure the germ is a waste of time, for the slight taste or odor imparted is soon dissipated in contact with the soil.

Similar experiments[2] conducted by B. M. Duggar and M. M. McCool, at the Agricultural Experiment Station of Cornell University, indicated that of a number of substances employed, turpentine emulsion and an anilin oil solution seriously affected germination. Such substances should be carefully avoided.

The manufacture of deterrents for use on seed grain has been undertaken on a moderate scale in this country, and a few articles of this nature also have been imported. Most of these appear to use coal tar or closely related products as a base; one at least contains a copper salt and is a poison; while the merit of one imported deterrent appears to be based on the fact that the treated seed is a brilliant blue. None of those tested by the writer has had any harmful effect on the seed; but there is no evidence that any of these manufactured substances is superior to coal tar as a deterrent when the latter is properly applied.

SCATTERING GRAIN.

Many farmers have had considerable success in protecting their sprouting crop by spreading broadcast over the fields a quantity of grain previously softened with water. This the birds take, leaving untouched that which has been planted. It has been found that a comparatively small quantity sacrificed in this way during the short period of a week or 10 days when spouting corn is subject to damage has often prevented loss to the growing crop.

POISONING.

Though the crow would be a most difficult bird to eradicate over any considerable area by a campaign of poisoning—a fact due largely to the bird's wariness—such a method has been found an effective means of protecting crops. When once a flock of these birds have learned through the loss of one or several of their number that a certain area has been baited with poisoned food they are inclined to avoid it for some time at least. In conducting such operations, however, local regulations governing the distribution of poison must be scrupulously observed, and as there is always an element of danger connected with the distribution of poison about thickly settled regions, its use should be limited and judicious.

---

[1] Kansas State Agr. Coll. Exp. Sta., Circ. 1, p. 3, Apr. 28, 1909.

[2] Cornell Univ. Agr. Exp. Sta., Circ. 6, pp. 14–16, May, 1909.

Corn is the bait usually employed in poisoning crows, and it is generally prepared by simply steeping the grain in a strong strychnine solution. If made, however, according to the following directions it will kill more quickly and its effectiveness will last for a considerable time when exposed to weather:

Corn	20 quarts
Strychnine (powdered)	1 ounce
Starch	2 tablespoonfuls
Water	1½ pints

Put the starch and strychnine in the water and heat to boiling, stirring thoroughly after the starch begins to thicken. Pour this mixture over the corn and stir till every kernel is coated. The seed may then be spread out and dried.

Experiments conducted in Klickitat County, Washington, demonstrated that where crows are troublesome to green almonds, relief may be secured by using these nuts as bait, prepared by splitting and inserting a quantity of a strychnine-saccharine mixture of about the size of a kernel of wheat. The poison mixture is composed of 8 parts of strychnine alkaloid and 1 of saccharine. The poisoned nuts are then placed in bare spots, two or three under each tree. While such a limited number of baits appears to be wholly insufficient to meet a situation where a flock of several thousand birds settle down on an orchard of a few acres, the results secured thus far have been most satisfactory. In attacking an almond crop, crows will first alight in the tree tops, knock down a few nuts, and then go to the ground to feed on them. For this reason conspicuously placed poisoned baits of this kind are almost certain to be taken, and as a few crows killed or seriously affected by the poison will suffice to make others shun the area, protection has been secured by one treatment that lasted a week or 10 days. By this means almond crops that in previous years had suffered losses sometimes totaling 100 per cent were but slightly damaged.

A successful bait has also been prepared by the use of partially blown hens' eggs into which a small quantity of strychnine has been injected. This has been effective in stopping the raids of the poultry and egg stealing crow. It should always be placed on the tops of straw stacks, in artificial nests erected on poles, or in inclosures from which poultry and all farm animals are barred. Strychnine may even be conveyed by meat or carrion used as baits, but the difficulty in keeping such baits away from domestic animals is great; they may be used to best advantage in winter, when crows are hard pressed for food.

TRAPPING.

Trapping at times has brought relief where other methods have failed. No wholesale reductions in the number of crows has ever been accomplished by this method, but when a few birds have been trapped and their dead bodies have been left exposed in the fields, their relatives are inclined to shun the immediate vicinity. Crows have been secured mainly in steel traps carefully baited with hens' eggs.

SHOOTING.

The unusual wariness of the crow has limited the effectiveness of firearms in reducing its numbers. However, these birds are inclined to shun those areas where the shotgun is frequently used. The use of crow decoys and crow calls has been resorted to with such success in attracting the birds within gunshot that these articles are now placed on sale by extensive dealers in sporting goods. A mounted specimen of an owl placed in a conspicuous position and within easy gunshot of the concealed hunter has also been used successfully in attracting numbers of crows to a point where they can be shot.

In eradicating objectionable winter roosts of crows, attacks on several successive nights by a number of men with firearms will frequently cause the birds to move on. Cartridges loaded with black powder are better than those containing smokeless, as the report is more deafening. When once a roost has been removed, vigilance must be employed for some time thereafter to keep it from being reestablished. In places where the discharge of firearms was inadvisable, Roman candles shot among the roosting birds have brought about the desired results, and on one occasion bunches of firecrackers thrown up into the tree tops caused the crows to seek a more peaceful community.

DESTROYING NESTS.

In sections where woodlands are close to farmyards containing exposed nests and young chicks, the destruction of a few crows' nests will greatly lessen depredations on poultry. The success of this measure lies in the fact that most of the crow's raids on the poultry yard are prompted by its desire to secure food for its young.

SUMMARY.

The crow is a bird whose size, ability to survive under diverse environments, and almost omnivorous food habits make it capable of doing both serious harm and extensive good. The influence of the race as a whole for good and harm appears to be about equal. Local conditions, however, greatly affect its economic status, and for this reason hasty judgment as to its worth should not be rendered, lest the bird be persecuted in sections where it is actually aiding the farmer. This bulletin has aimed to point out briefly the benefits to man from the crow's food habits, as well as the ways in which the bird may do harm. Indiscriminate killing is not warranted, and even in areas where the crow is doing harm preventive measures will often put a stop to the nuisance and allow the bird to continue what good work it may be doing on insects. Among the preventive measures are—

(1) The use of coal tar or other deterrents on seed grain.

(2) Scattering grain over fields where the crop is just sprouting.

(3) Stretching twine about and across fields from poles stationed at intervals. A network of such strands is often effective in protecting poultry yards.

(4) The use of frightening devices and the hanging up of the dead bodies of crows in conspicuous places.

In places where more drastic measures are necessary the killing of even a few crows will intimidate others and these will usually shun the area for some time. Such procedures include—

(1) The use of poison (strychnine) in places where this is permitted by law. Corn and hens' eggs are the most effective baits.

(2) Trapping by means of steel traps, carefully concealed and baited with hens' eggs.

(3) Destroying nests—a measure that will most frequently put a stop to the poultry-raiding activities of a pair of crows which have their nest near by.

(4) Shooting—the hunter being aided by the use of a crow call and, where possible, also by a mounted owl placed conspicuously on a pole. Several night attacks by a number of men equipped with shotguns will frequently remove objectionable winter roosts.

15

FARMERS BULLETIN 1103
United States Department of Agriculture

Growing Irrigated Grain in Southern Idaho

THE PRODUCTION OF CEREALS under irrigation in southern Idaho was greatly stimulated by war-time needs. Small grain on irrigated land was not previously regarded as profitable in comparison with other crops except as the first crop on new land.

The growing of cereals is essential to the development of the live-stock industry and also to the safe diversification and proper rotation of crops. This is especially true in southern Idaho, at a long distance from market.

When given the same care that is bestowed on sugar beets and alfalfa, the small grains give good returns. They are especially adapted where irrigation water is limited.

The preparation of the land for irrigation and seeding is very important. Care in leveling is well repaid in time saved in irrigating and in better yields and more uniform quality.

Clean seed of the best adapted varieties, treated to prevent smut and properly drilled on a well-prepared seed bed, go far toward insuring a good yield.

Dicklow and Pacific Bluestem wheats; Golden Rain, Early Mountain, Silvermine, and Kherson oats; and Trebi, Beldi, and Hannchen barleys are the leading varieties.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. May, 1920

GROWING IRRIGATED GRAIN IN SOUTHERN IDAHO.

L. C. AICHER,
Agronomist and Superintendent, Aberdeen Substation, Aberdeen, Idaho, Office of Cereal Investigations.

[In cooperation with the Idaho Agricultural Experiment Station.]

CONTENTS.

	Page.
Cereals important in Idaho	3
The Snake River basin	4
Leveling for irrigation	7
Leveling and tilling machinery	8
Seed-bed preparation	9
Cereals in the rotation	10
Seed and seeding	12
Methods of irrigation	14
Results at the Aberdeen substation	18
Harvesting and thrashing	26

CEREALS IMPORTANT IN IDAHO.

CEREALS constitute some of the most important cash and feed crops grown on the irrigated lands of southern Idaho. Until the outbreak of the World War the increase in the production of wheat, oats, and barley had been gradual and had kept pace with the areas of new land placed under irrigation. The acreage of wheat during the war was greatly increased at the expense of oats, alfalfa, clover, and other crops. A slight increase in the acreage of barley resulted from the demand for this grain as a substitute for wheat in bread making. The small grains have been used almost exclusively as the first crop in bringing the virgin soils under cultivation. This is due to the ease with which the grains can be grown, the small seed cost, the practically assured returns, and the ready market, particularly for wheat. Interest in the production of barley is spreading quite rapidly, as the feeding value of the grain becomes more generally known.

The increased production of cereals, especially barley, has had a stimulating effect upon the live-stock industry, which has prospered in southern Idaho. Feed has been plentiful, and the moderate winters encourage the wintering of stock which would otherwise be shipped out of the country. The long distance from market makes it imperative that the live-stock industry be fostered to the fullest extent. Grain production in itself is not a profitable type of agriculture for irrigated lands. The home feeding of bulky crops which are expensive to ship not only brings in higher net returns by saving shipping costs, but also assists greatly in maintaining the fertility of the soil and the permanency of the agriculture. The diversification of crops overcomes losses occasioned by market fluctuations, which would otherwise be disastrous under a system of single cropping. This diversified agriculture and increase in live stock has been fostered considerably by a rational policy for the control of forest range and leased range, which permits the owners of small farms to obtain range for a few head of stock.

THE SNAKE RIVER BASIN.

This bulletin is intended primarily for settlers on the irrigated lands of the Snake River basin in southern Idaho. This territory includes irrigated lands in every county in the southern and southeastern parts of the State. Figure 1 shows a map of Idaho and the approximate location of the irrigated areas in each of the southern counties. The estimated irrigated area of southern Idaho is 1,723,278 acres and is constantly being increased as new lands are made ready for irrigation. Some of these districts have more water for crop production than others, depending to a considerable extent upon the priority of water rights. A few sections have priority rights, but the original supply of water has never been adequate. The drought of 1919 stimulated great interest in additional storage capacity to insure a reserve for dry seasons.

CLIMATE.

The general climate of the Snake River basin is arid or semiarid The altitude varies from about 6,000 feet in the Teton basin, near the headwaters of the Snake River, to about 2,100 feet in the lower part of the basin near the Oregon line. The great variations in altitude cause corresponding variations in the temperature and in the length of the growing season. In the upper part of the valley the temperature seldom exceeds 90° F. in summer or falls lower than 15° to 20° below zero in winter. At the lower altitudes near the Oregon line summer temperatures of 100° F. or higher are often reported, while the winter minimum seldom reaches zero. Throughout this basin the daily range of temperature is very great.

The average annual precipitation at the substation at Aberdeen Idaho, for the six years from 1913 to 1918 was 9.59 inches. The average for the various irrigated sections of the State varies from 8 to 12 inches per annum. The precipitation is greater in the mountain valleys than on the plains. The distribution of the summe rainfall is very irregular, as will be noted in figure 2.

Warm chinook winds often cause rapid melting of the light snowfall on the plains, resulting in the escape of the moisture as run-off, if the ground is frozen. In the mountain valleys snow falls relatively early in the autumn and usually remains until spring weather arrives. As a rule, the ground is seldom frozen in these higher valleys where early deep snows prevail. Westerly winds prevail over southern Idaho. In summer and fall the winds frequently are strong in the afternoon. The average daily wind velocity in the months of April, May, June, July, August, and September, as recorded at the Aberdeen substation during the six years from 1913 to 1918, inclusive, was 5.82 miles an hour. The average daily evaporation from a free water surface during the same period was 0.209 inch.

The average date of the last killing frost in the spring is June 8, and of the first killing frost in the fall September 16. The average length of the growing season, that is, the frost-free period, at Aberdeen is 101 days. In the upper Snake River valley the frost-free period is shorter, and n the lower part of the valley near the Oregon line it is much longer.

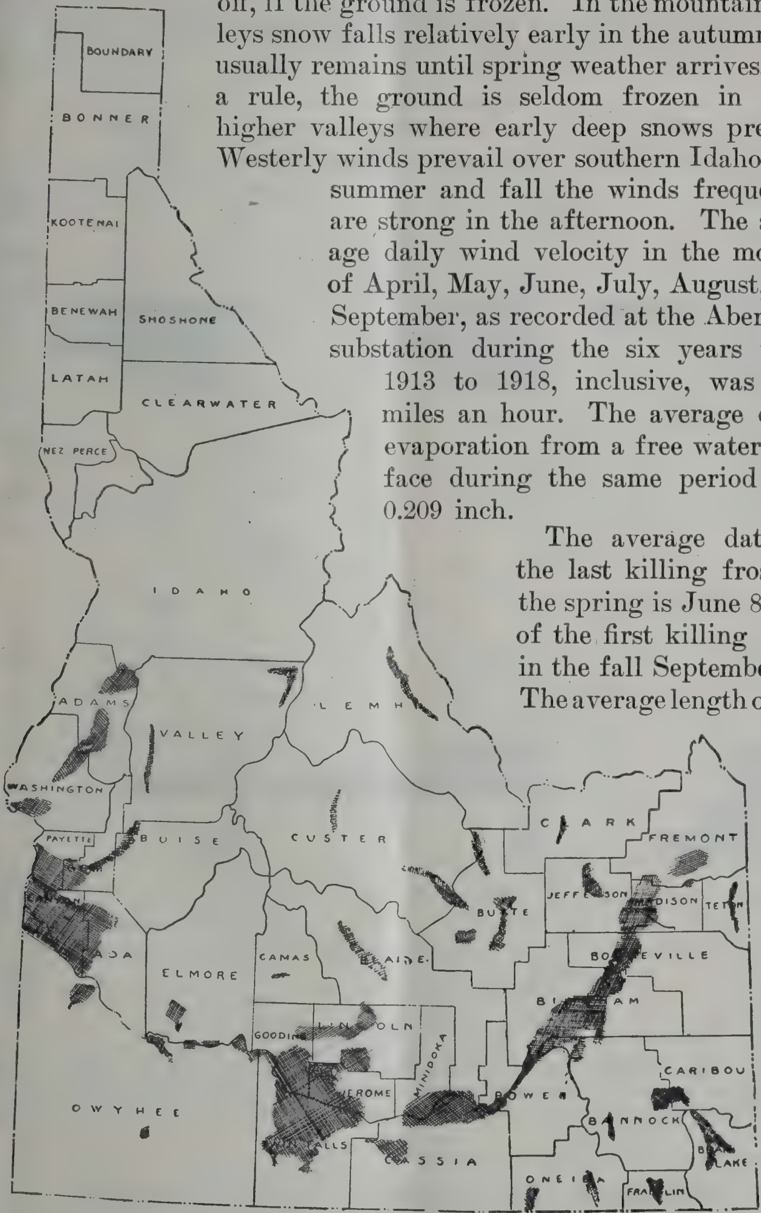


FIG. 1.—Outline map of Idaho, showing approximately the area of irrigated land in each of the southern counties.

SOILS.

The soils of southern Idaho are of volcanic origin. Most of the soil covering the plains at a distance from the mountains and the outside canyons is fine material redeposited by the wind. It is a yellowish white silt, composed mainly of fine quartz particles. The most common soil type is a sandy clay loam. A considerable portion of the soil in the irrigated portions of the mountain valleys is composed of mountain wash or alluvial soil. This soil is also a sandy clay-loam type, but it contains more decayed vegetable matter. The upper Snake River valley soils contain more sand and gravel than

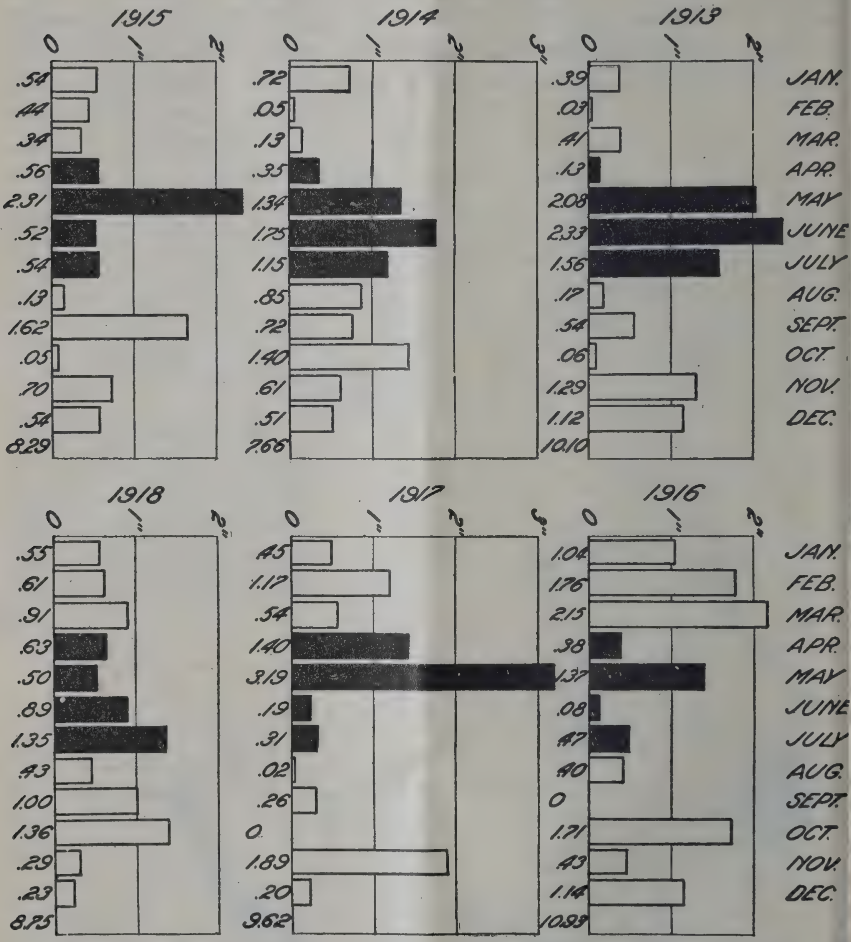


FIG. 2.—Graph showing monthly, seasonal, and annual precipitation, in inches, at the Aberdeen substation, Aberdeen, Idaho, during the six years from 1913 to 1918, inclusive. The precipitation during the growing season (April to July, inclusive) is indicated by shading.

those of the lower valley, and the color is generally darker, often a reddish brown at the high altitudes. The soils in some parts of the upper Snake River valley, probably the old river bed or former flood plain, contain much gravel and as a rule require much more water to produce a profitable crop than the normal soils.

The mineral plant foods are abundant in the soils of southern Idaho. Humus and nitrogen are the two substances lacking, but under irrigation these can be supplied by the growing and plowing under of leguminous crops, such as alfalfa and clover, as well as by the use of manures. The great abundance of lime in the soil enables these crops to grow vigorously. In a few sections of the State natural drainage is not sufficient. In these places, water-logging has occurred, with the consequent rise of alkali and loss of cropped land. Artificial drainage in these sections is being undertaken with much success. This condition should be anticipated by the farmers in sections where the land is relatively flat and water-logging is likely to develop. Much loss of land, labor, and money could be avoided by providing drainage soon after the irrigation system has been established.

LEVELING FOR IRRIGATION.

The best returns from cereals grown under irrigation can be obtained only when the land has been well leveled. Properly leveled lands permit easy, thorough, and complete irrigation. Poorly leveled lands are expensive to irrigate, require more water and more labor than land well leveled, and return a less yield per acre. Spots too high to receive water should be cut down and used to fill up "potholes," where water naturally collects. Some objection to removing the high spots is made, because the subsoil is thereby exposed and unproductive spots result. However, a spot too high for watering is just as unproductive, and remains permanently so, whereas the southern Idaho subsoil, if exposed through leveling, can soon be made productive by the use of manures and alfalfa. Before the leveling operation is begun, the general contour of the land should be well noted. Natural drainage should be left open so far as possible. The leveling should conform so far as possible to the natural contour of the land.

Before the leveling is begun, it should be decided whether the check method, the border method, the corrugation method, or the regular contour flooding method is to be used. Land sloping in more than one direction is best irrigated by the corrugation method, unless the slope is only slight, in which case the border method can be used. The normal flooding method can be used if the field laterals are comparatively close together, at most not over 300 feet apart. So far as possible, water should be allowed to take the direction of its natural flow. Very sloping land is best irrigated by the corrugation method, and the corrugations should be coursed around the hill rather than straight down the slope. Washing will result otherwise. Such land, to overcome washing, should be used for hay or pasture.

The best time to do leveling is in the fall, before the land is plowed, as the leveled and plowed land can settle during the winter and be in ideal condition for seeding in the spring. It is not advisable to plow the entire field before leveling is begun. More horse power is required to pull the scraper over plowed land than over firm land. Furthermore, it is much more difficult to be sure when the land is level, because fresh plowing is easily tramped down in scraping and looks lower than adjacent untramped plowing. Plow or double disk only the high spots and haul the dirt from these to adjacent unplowed lower ground. Irrigators become very proficient in locating high and low spots and often do not require the aid of an instrument in leveling land. The use of an instrument, however, makes leveling certain and often prevents loss.

After the land has been fairly well leveled, the field should be double disked and floated and a trial irrigation given. As soon as the land is dry enough to work, the few spots needing additional leveling should be given attention and the field can then be plowed. The irrigation which the field has received will make it easy to plow, and the land will firm and work down well.

LEVELING AND TILLING MACHINERY.

There are many implements from which to select for use on irrigated lands. The equipment for an irrigated farm of average size should include a 14-inch or 16-inch two-way sulky plow for general field plowing. It is desirable to have a 14-inch walking plow for ditch making, cleaning, and plowing corners too small for the two-way sulky. A disk harrow and a common spike-tooth harrow should be provided, in addition to a spring-tooth harrow, a tool especially adapted for alfalfa cultivation. A wooden float at least 14 feet long and from 6 to 10 feet wide, depending upon the horse power available, is an absolute necessity. A scraper (fig. 3) is an essential implement wherever much leveling must be done. For firming soil, a corrugated roller is an essential implement on any well-diversified irrigated farm and is of particular value in sugar-beet growing. Various forms of crowders are in use for opening ditches. A good homemade V-type crowder in use at the Aberdeen substation is shown in figure 4, while an excellent ditcher, which can be bought ready made, is shown in figure 5.

SEED-BED PREPARATION.

A seed bed for cereals must above all else be firm and yet well fined. This means not pulverized so fine that it will blow, but that it is free from lumps. A firm seed bed, such as is provided by fall plowing and early spring preparation, will be found to give excellent stands of small grains. Spring-plowed land can be worked down sufficiently to make a good seed bed, but requires more work than when the land has been fall plowed. The long winter settling of fall-plowed land provides a firm seed bed which can be obtained in no other way. Corrugated rollers, packers, and disk harrows with disks set straight are all used in firming spring-plowed land. The corrugated roller probably is the best implement to purchase, as it can be used for other purposes as well. For completing the leveling of the land, a float (fig. 6) is useful.

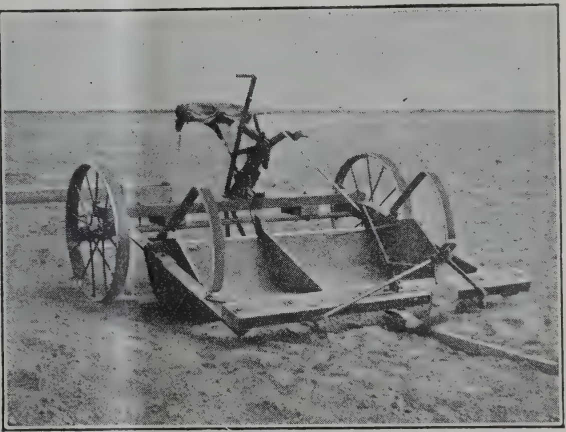


Fig. 3.—One of the best types of automatic scrapers and land levelers for use in preparing land for irrigation.

Sugar-beet land or potato land, if free from weeds and trash, need not be plowed in preparation for a seed bed for cereals. A good job usually can be done with the disk harrow or spring-tooth harrow on such land and much time and labor saved. Land on which alfalfa was plowed under will produce an excellent crop of small grain if care is taken in plowing and preparation. The best seed bed on alfalfa land can be prepared by the method of double plowing. This consists in cutting the crowns of the alfalfa by plowing as shallow as possible and later plowing this crowned land 6 to 8 inches deep, turning under the crowns. In addition to turning under the crowns to kill them and to prevent trouble in leveling, much additional plant food is provided for the immediate use of the crop. Clover requires but one plowing, and if done in the fall an excellent seed bed can be prepared. Leveling land for irrigation is very important and must be kept in mind in seed-bed preparation.

The two-way plow is by far the best tillage implement for an irrigated farm. This plow, if handled properly, saves much of the work of leveling for irrigation, as no dead furrows are made by it. Hillsides and ditches may be leveled to a great extent by the use of the two-way plow, as the furrows may all be turned one way.

CEREALS IN THE ROTATION.

On well-leveled highly productive irrigated land the cereal crop is regarded as the least profitable crop grown in the rotation. The usual rotation of crops in the better farmed sections of southern Idaho includes alfalfa three or more years, then beets or potatoes two to three years, and then cereals two or three years, with the last crop used as a nurse crop for alfalfa. A variation of this rotation has clover instead of alfalfa for two years, beets or potatoes two years, and cereals one year, the land then being seeded back to clover. This rotation is particularly well adapted to clover-seed production, as it eliminates weeds and removes a great amount of plant food, so that the clover crop will not make too much growth. A heavy vegetative growth of clover is not favorable to seed production.

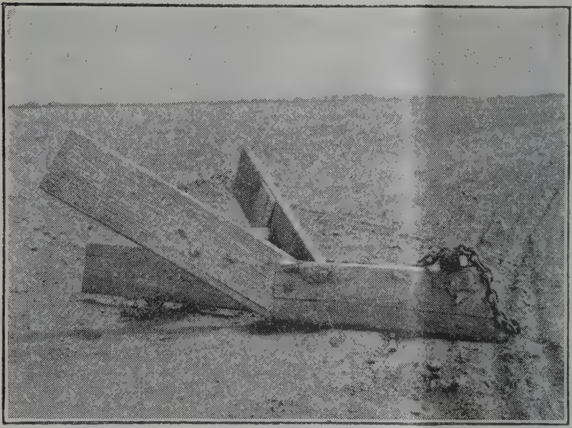


FIG. 4.—A homemade crowder.

A cereal rotation adapted to live-stock production would include alfalfa three or four years, root crops one year, and cereals two or three years, with alfalfa sown in the last cereal crop. This rotation will suit any live-stock farm where hay, grain, roots, and silage are used in feeding. Corn for silage can be substituted for some of the small grain in the rotation.

WINTER GRAIN NOT ADAPTED.

Winter grains are not adapted for use in any rotation system on irrigated land. Winter wheat is not economically profitable from a labor standpoint and, in addition, does not yield as well as spring wheat. If the winter wheat used is a hard red variety, it usually will contain a high percentage of yellow berry when grown under irrigation and is subject to a low grade under the new wheat-grading standards. It is better to fall plow the land and prepare a good seed bed for early spring seeding than to sow winter wheat and run the chances of loss by winterkilling, reduced yield, and low grade.

Winter oats and winter barley do not survive the winter and hence are not of commercial value in southern Idaho.

WHEAT, OATS, AND BARLEY AS NURSE CROPS.

Wheat, oats, and barley are used as nurse crops for alfalfa and clover. Practically all fields seeded down to alfalfa and clover in southern Idaho are sown with a nurse crop. Good stands usually are obtained, and the nurse crop, which nearly always is cut for grain, is remunerative. Early varieties should be used whenever available, so that the crop may be removed as early as possible and water applied to the young clover or alfalfa plants.

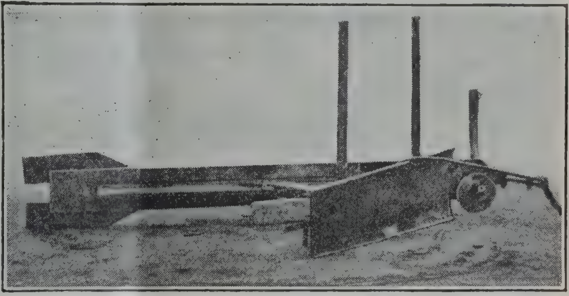


FIG. 5.—One of the best types of ditcher.

Barley is preferable to wheat or oats as a nurse crop, as it matures earlier and does not shade the ground as much as oats or wheat. Varieties of 6-rowed barley are better than most 2-rowed varieties, because they ripen a week to ten days earlier and the better 6-rowed varieties outyield the 2-rowed types.

It is advisable to reduce the rate of seeding of the nurse crop to about three-fourths of the normal rate when sown alone. The nurse crop may be sown early and allowed to grow to a height of 4 or 5 inches before the clover or alfalfa is seeded. In that event the legumes should be sown broadcast, preferably with a grain drill, in order that even distribution may be obtained. Clover or alfalfa should not be sown with the grain, that is, running into the same drill row and at the same depth as the grain. If time is not available to sow the alfalfa or clover after the grain has been seeded, it is advisable to take the lower ends of the spiral spouts out of the openings of the drill hose and straighten them out, so that the seed is sown broadcast ahead of the drill. Most of the seed is covered in this way, but the disadvantage is that the clover or alfalfa seeds are not all covered to the same depth. An uneven germination and only fair stands often result.

WHEAT, OATS, AND BARLEY IN MIXTURES.

Oats are used more than wheat or barley on irrigated lands for growing in mixtures for hay or silage. Oats and peas make an excellent hay combination where alfalfa or clover hay is not available. The Animal Husbandry Department of the University of Idaho has grown peas combined with oats and with wheat for silage, and these mixtures have been very satisfactory when fed to live stock in comparison with corn silage. The combinations are particularly valuable in the upper Snake River basin, where corn is more or less likely to be injured by frosts and where the tonnage of corn silage is not great, owing to the slow growth made at high altitudes. The Silvermine is an excellent variety for use as a hay and forage oat in such mixtures. A mixture of 50 pounds of oats and 100 pounds of peas per acre makes a good combination if sown early. Figure 7 shows a fine crop of peas and oats during harvest.

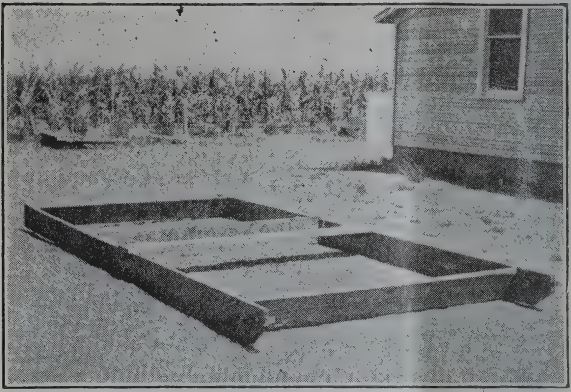


FIG. 6.—A float used for leveling and completing the preparation of a good seed bed on irrigated land.

SEED AND SEEDING.

CLEANING THE SEED.

Seed should be cleaned well before sowing. Chaff and straw clog up the drill and a good stand can not be obtained. Sowing shrunken and cracked grain causes losses in stand, as only a small part of such seed grows and at best will produce only weak plants. Such seed is valuable for feed and should not be wasted by sowing it.

Plump seed also is less injured by the treatment to prevent smut and always germinates better than shrunken or light seed. The varieties recommended in this bulletin may be obtained from the Aberdeen substation or other reliable local sources.

TREATMENT TO PREVENT SMUT.

If the grain has been previously fanned and all smut balls removed, the seed is ready for treatment. The formaldehyde treatment for stinking smut requires soaking the grain from 5 to 10 minutes in a solution of 1 pint of commercial formaldehyde to 45 gallons of water.

If reasonable care is exercised in the formaldehyde treatment, the loss due to injury can be reduced to a very small percentage. Injury from the use of formaldehyde usually is due to overtreatment. It s not necessary to soak the grain more than 10 minutes in the formaldehyde solution. Five minutes often will suffice. After the seed has been soaked for 5 to 10 minutes, the solution should be drained off and the grain piled up and covered for about two hours to thoroughly distribute the formaldehyde gas throughout the pile. The seed should then be spread out thinly and dried sufficiently to run hrough a drill. The best results will be obtained if the grain is sown just as soon as it is sufficiently dry. For further information on he smuts of cereals and their treatment, see Farmers' Bulletin 939, entitled "Cereal Smuts and the Disinfection of Seed Grain."

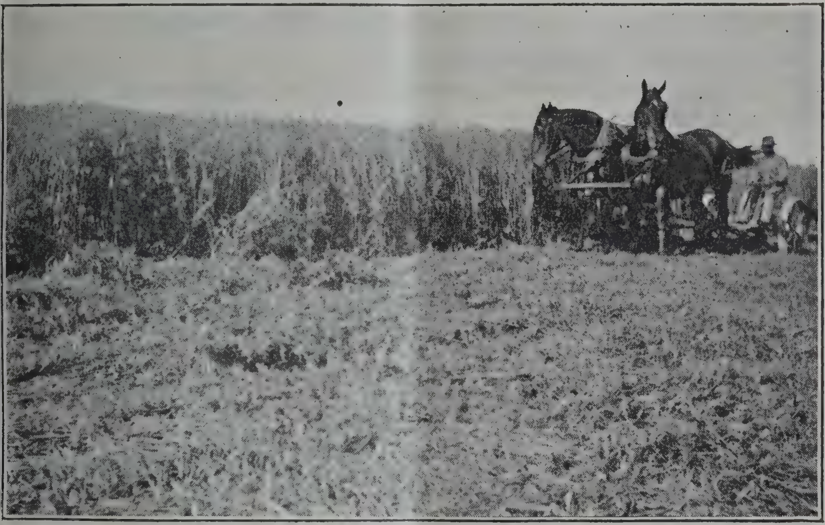


FIG. 7.—An excellent crop of oats and peas at the Aberdeen substation.

EARLY SOWING OF CEREALS.

Wheat, barley, and oats should be sown early to secure the best esults. At Aberdeen, sowing ordinarily can be begun about the middle of April. In the upper Snake River basin, seeding can be done in May. At the high altitudes, the farmers, realizing that he season is short, lose no time in getting their grains into the ground. At the lower altitudes, where the season is relatively long, eeding usually is postponed, not from necessity but simply because he crop will mature although seeded late. Growers who thus postpone seeding probably do not realize that early sowing will give greater returns. Small grains require some cool weather during the period of early growth, in order to tiller properly. Late-sown crops do not tiller nearly as well as early-sown crops.

GRAIN DRILLS.

There is no longer any question among Idaho farmers as to tl advantage of drilling seed over broadcasting. There is still son controversy as to whether a 6-inch drill is better than one with dril spaced 7 inches apart and also whether a 3½-inch drill is better tha either of these. Doubt also exists as to the relative merits of dis shoe, and hoe drills.

Both 6-inch and 7-inch drills are used extensively on irrigate lands and are satisfactory. The 6-inch drill is coming more and mo into favor for well-tilled land. Drill rows spaced closer than thi however, have little to recommend them for irrigated lands. If th grain is sown early, the plants tiller freely, and the space betwee these drill rows is quickly filled up. Cross drilling is favored by som farmers to obtain a thick stand.

The main reason for sowing closely is to eliminate weeds. On th other hand, where grains are to be used as nurse crops, the very clos drill rows are particularly objectionable, because very thick seedin chokes out the leguminous crop. No information is available to sho that yields from grain sown in closely spaced drill rows are bette than those obtained from 6-inch or 7-inch drill rows.

Single-disk drills are especially useful on land which is some what trashy. These drills also will do very good work on clean lanc The double-disk drill, the hoe drill, and the shoe drill are most usefu on clean land.

QUANTITY OF SEED TO SOW.

The rates of seeding cereals on the irrigated lands have been grad ually increased. This is due in part to soil improvement and the con sequent ability of the richer soil to support a heavier stand. In th early days of irrigation farming in southern Idaho 6 pecks of whea was considered an ample seeding, but 2 bushels per acre is now be coming a very popular rate of seeding for wheat on well-improve land. Oats should be sown at 2½ to 3 bushels per acre, and barle from 2 to 2½ bushels per acre. If the grain is swollen from seed treat ment, the drill openings should be slightly increased to insure sowin at the proper rate. When cereals are used as nurse crops the rate o seeding should not exceed three-fourths of the normal quantity.

METHODS OF IRRIGATION.[1]

As a rule, less care is taken in preparing irrigated lands for grair crops than for any other crop. This is due in part to the fact that grain will produce some sort of return under very adverse conditions;

---

[1] For more complete information on this subject the reader should consult Farmers' Bulletins 863, entitled "Irrigation of Grain," and 864, entitled "Practical Information for Beginners in Irrigation." These bulletins may be obtained free on application to the United States Department of Agriculture.

herefore, much is left to chance. Another reason for less attention eing given to land producing these crops is that grain has been onsidered one of the least profitable crops grown on irrigated land. High prices during the war period, however, stimulated production, nd many farmers have learned that large yields of grain can be btained if attention is given to land preparation and proper rrigation.

Irrigation water may be applied in several different ways. Floodng is the most common method in use. Irrigation by the border method and also by the corrugation method is becoming quite general n southern Idaho. Each system has its limitations, but both are good, and a combination of the two gives excellent results. The heck method is less commonly employed.

THE FLOODING METHOD.

Flooding is the original method of irrigation and may be done in ny one of several ways. The most common way is by flooding from eld laterals. This method consists of running small ditches across he field in such a way as to permit the water to be carried to all parts, and letting it out of these ditches without other direction than s given it by the irrigator with his shovel.

THE BORDER METHOD.

A border is a low rounding levee just high enough to prevent the water from overtopping it in its course down the slope and yet permit seeding and harvesting machinery to pass over it without injury. The borders, or levees, are made by back furrowing with a plow or y scraping together soil not required for filling depressions.

The border method is only a modification of the flooding method. t consists of making a series of parallel levees or borders at intervals f 50 to 100 feet down the slope from the supply ditch. The purose of these levees is to guide the water down the slope. The order method is coming into more general use in Idaho as its adantages become apparent. It is particularly well adapted to level land or land with little slope. The more sloping the land the closer ogether should be the borders. The land between borders should e leveled so that the water will cover all the surface evenly as it progresses down the field.

Preparing land for border irrigation requires more labor than preparation for normal flooding. The labor cost is quickly made up, owever, in the time and money saved in irrigating and the increased ields which result. If the leveling has been well done, the borders will require but little attention other than turning in the water.

The length of the borders will depend considerably upon the haracter of the soil. Sandy or gravelly land will permit only short flows before the water disappears in the subsoil. Long flows can be made on the heavier soils, but at most a 600-foot flow is long enough. A waste ditch should be provided at the lower end of the border and another set of borders begun. A field ditch at right angles to the supply ditch is required to supply water to these lower borders. Borders of the same length are desirable and should be made wherever the contour of the land permits. A farm with border units of uniform lengths can be handled much more easily in a system of crop rotation than one with units of different lengths.

An irrigation system well constructed for use of the border method will permit large heads of water to be used except on very heavy soils, and to this end good-sized ditches should be provided. Large heads forced over quickly and at comparatively short intervals of time reduce labor costs, insure thorough irrigation, and are better for the crops being irrigated than heavy irrigations at long intervals.

THE CORRUGATION METHOD.

Corrugations are small furrows opened by means of a shovel attachment on a beet cultivator or by an implement called a corrugator. The corrugations vary in spacing from 12 to 24 or more inches, depending upon the nature of the soil. The corrugation method is particularly well adapted to uneven or sloping land. On decidedly sloping land the corrugations are coursed around the hills rather than straight down, in order to avoid washing. Corrugating must be done immediately after seeding and before the grain has started to sprout. On most Idaho soils corrugations spaced 14 to 16 inches apart give the best results. A field irrigated by the corrugation method is shown in figure 8.

THE CHECK METHOD.

In the check method, the field is divided into basins or checks by means of low levees. Water is admitted to the checks in turn and allowed to flow until the entire surface is submerged. The slope of the land within a check must be less than the height of the levees, in order that all parts may be submerged without causing the water to overflow. On the other hand, the levees must be low enough to permit farm machinery to pass over them. For these reasons the check method is adapted only to land having a gentle slope, as on land having a steep slope the levees would have to be too close together to be practicable.

The borders of the checks are made in the same way as the borders for the border method. The check method is an ideal method of applying water. If properly operated it absolutely prevents surface waste. Care must be taken, however, to shut the water out of a check as soon as the soil is properly moistened, since too much standing water on plants will cause serious injury to the crop.

WHEN TO IRRIGATE GRAIN.

Grain should be irrigated when the crop needs water, regardless of the stage of growth of the grain. Set rules for the irrigation of any crop are misleading, and any attempt to follow them rigidly often results disastrously. Seasons vary, and the time to irrigate a crop varies considerably with the season. Summer rains often are misleading, unless they exceed a half inch. Every year they are indirectly responsible for considerable loss in the irrigated sections. In southern Idaho, where the average precipitation during the growing season is 4.27 inches, it is a mistake to take the average shower too seriously. The immediate surface moisture is of little value in crop production, and unless the ground is moist to a considerable depth the crop should be irrigated, regardless of the little moisture from small rains.

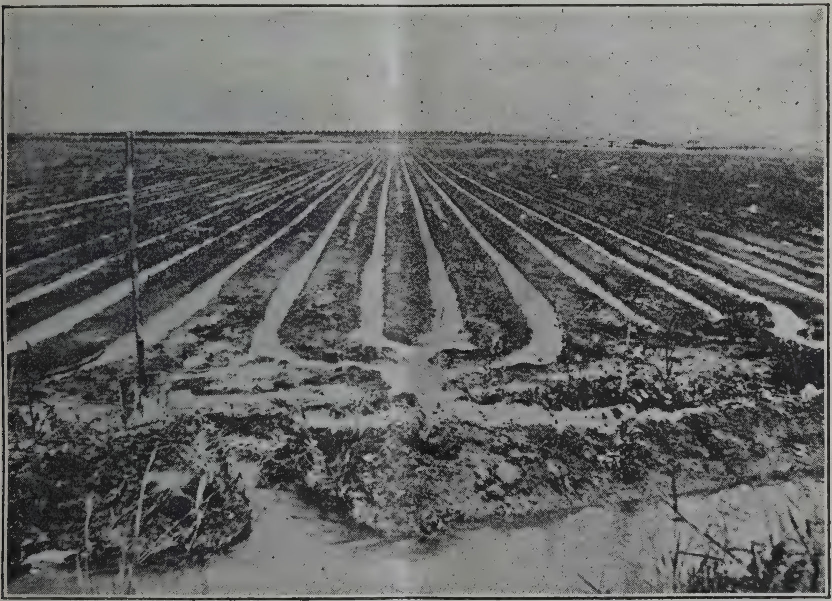


FIG. 8.—Land irrigated by the corrugation method.

The time to apply water to grain can be determined very well by the color of the foliage. Grain crops not having sufficient water become dark green, and the leaves droop considerably during the warmer parts of the day. Plants having sufficient water have a bright-green color and the leaves seldom droop unless the weather is intensely hot. An experienced irrigator can tell, by handling the soil immediately below the surface, when water must be applied. By associating the color of the foliage, the drooping position of the leaves, and the "feel" of the soil, an experienced irrigator can always tell when to apply water and about how much to apply. Grain should not be permitted to burn, as the growth is checked thereby and yields reduced. On the other hand, too much irrigation will produce too much straw, at the expense of the seed yield. Irrigation should be held off as long as possible during the early stages of growth, in order to prevent too vigorous a growth of straw, particularly if the grain is on alfalfa land or other highly enriched soil.

Three or four irrigations in the average season should be sufficient. The crop will do better if the moisture content of the soil is kept fairly constant, and for this reason several light irrigations at frequent intervals will give better results than a smaller number of heavy irrigations at long intervals.

Grain should not be watered, if possible, until after sufficient growth has been made to shade the ground. Occasionally, the precipitation in winter and early spring is not sufficient to cause the grain to make such a growth. In that event, the field should be irrigated by means of corrugations, but not flooded. Flooding land before the crop shades the soil will cause the baking of all except very sandy or gravelly soils. A hard crust will be formed which prevents air from reaching the roots and retards growth, often killing many plants. Rarely, it may be necessary to irrigate before seeding, if the spring is unusually dry.

RESULTS AT THE ABERDEEN SUBSTATION.[1]

Work at the Aberdeen substation was begun in 1912. The land was cleared of brush, plowed, and made ready for seeding. Ditches on the irrigated portion were laid out and constructed and the land leveled. Varietal experiments with cereals were begun in 1913. Individual plats were used for three years, with checks at intervals of five plats. In 1916, duplicate fortieth-acre plats of all varieties were established and have been continued to date. In the fall of 1918, operations were begun to irrigate the entire substation, part of which had previously been dry farmed.

In addition to handling many varieties in the field plats, a nursery of many hundreds of varieties and strains of small grains has been conducted, looking toward the improvement of these crops in southern Idaho.

Cereals always have followed potatoes in the rotation at the Aberdeen substation. The rotation consists of alfalfa four years, then potatoes, cereals, and peas, after which peas or cereals are used as a nurse crop for alfalfa. After the first cereal crop is removed, 15 to 20 tons of manure per acre are spread on the land. This is plowed under in the fall and peas sown in the early spring. If it is desired to get the land back to alfalfa earlier than the above rotation permits, alfalfa may be sown with the first pea crop, thus gaining one year. Grain seems to do better following potatoes or sugar beets, and the field is free from weeds if the potato and beet crops have been given the attention necessary for high yields.

---

[1] The experiments at the Aberdeen substation are conducted in cooperation with the Idaho Agricultural Experiment Station, and joint credit is due that station for the results presented here.

Seed of the varieties recommended in this bulletin usually can be purchased at the Aberdeen substation.

WHEAT.

Table I shows the results of experiments with the leading spring wheats on irrigated land. The experiments included 16 varieties during the six years from 1913 to 1918, but only eight varieties were grown during as many as four seasons. Of these eight, only four were grown during the entire six years.

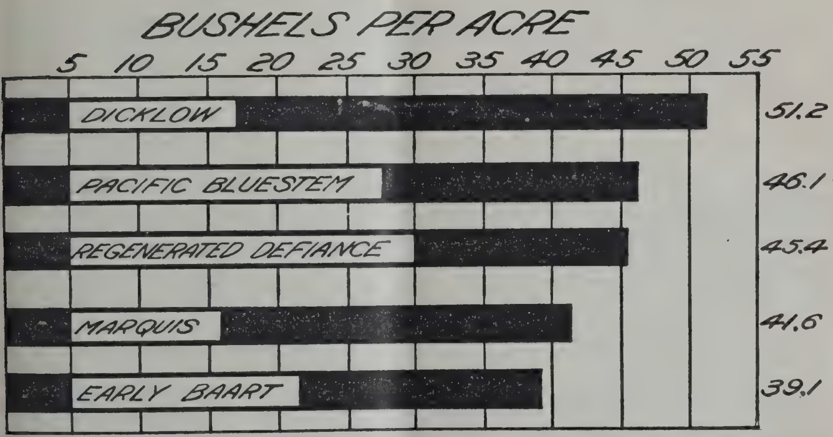


FIG. 9.—Diagram showing the average yields, in bushels per acre, of the highest yielding varieties of spring wheat grown on irrigated land at the Aberdeen substation in the six years from 1913 to 1918, inclusive.

Figure 9 shows graphically the average acre yields, in bushels, of the five leading varieties of spring wheat grown on irrigated land at the Aberdeen substation in the 6-year period from 1913 to 1918, inclusive.

The Dicklow has outyielded the other three varieties grown in all six years by an average yield of 5.1 bushels per acre each year, or a total of 30.6 bushels in six years. The Dicklow is a soft white wheat. The head is of medium length, broad and compact, often club shaped, beardless, with smooth, white chaff. The origin of the wheat is not definitely known, but all information thus far obtained indicates that it is a selection from the old California Gem or California Club.

Mr. James Holly, of Utah County, Utah, obtained some California Club wheat from northern California and seeded it on his farm. Excellent results were obtained, and he called the attention of his neighbor, Mr. Richard Low, to his new wheat. Mr. Low obtained some and grew it. He noticed that the wheat contained different types and proceeded to select the type which he liked best. He grew this selection for several years, and the neighbors soon began clamoring for "Dick" Low's wheat. As the wheat became spread over that section of Utah, it lost its personal connection with "Dick" Low and became known simply as Dicklow wheat.

TABLE I.—*Yields of eight varieties of spring wheat grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

Variety.	C. I. No.[a]	Yield per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average. 3 years, 1914 to 1916.	Average. 6 years, 1913 to 1918.
Dicklow	3662	61.5	38.0	56.7	52.0	62.3	36.9	48.9	51.2
Pacific Bluestem	4067	42.0	38.9	60.3	54.0	51.0	30.6	51.1	46.1
Regenerated Defiance	3703	56.6	41.2	47.9	48.0	50.3	29.0	45.7	45.5
Marquis	3276	33.3	38.9	56.7	52.0	41.3	27.6	49.2	41.6
Early Baart	1697	....	38.8	31.5	54.0	43.0	28.3	41.4	[b] 39.1
Little Club	4066	41.3	41.2	49.9	50.0	....	....	47.0	....
Glyndon Fife	2874	....	42.3	49.0	41.3	36.0	....	44.2	....
Haynes Bluestem	2873	36.0	27.4	38.7	34.6	44.6	....	33.6	....

[a] Cereal Investigations number.

[b] Average for only five years, 1914 to 1918, inclusive.

In 1912 or 1913, Mr. John Breckinridge, manager of the Western Milling & Elevator Company, shipped into Twin Falls, Idaho, a considerable quantity of Dicklow wheat, and it became fairly well distributed over Twin Falls County. Mr. Carl Irwin, a farmer of Kimberley, Idaho, has made special efforts to improve the variety by selection and has obtained a very uniform type. Figure 10 shows a field of pure Dicklow wheat which averaged 60 bushels to the acre.

The variety is particularly well adapted to the irrigated lands of southern Idaho. It is not a specially good milling wheat when compared with the Turkey wheat grown on the dry lands, but it ranks well with other white wheats grown under irrigation in southern Idaho. The flour from the Dicklow wheat is particularly adapted for use in pastry, biscuit, and cracker making. Owing in part to these special qualities, much of the Dicklow wheat flour made in southern Idaho is shipped to the Southern States. Some Dicklow also is used to blend with hard wheat in the manufacture of bread flour. Before the World War, southern Idaho farmers fed considerable wheat to hogs.

The Dicklow wheat has a good, stiff straw, is of medium height, and stands up well under irrigation. When ripe, it shatters more easily than the Pacific Bluestem, but if cut when in the late hard dough stage it will not shatter. The average length of the growing period (days from sowing to maturity) of the Dicklow wheat under irrigation at Aberdeen has been 118 days. The Bluestem requires 117 days, the Marquis 112, and the Early Baart 106 days. The Bluestem and Defiance are objectionable because of the long straw produced when grown on fertile irrigated land. As soon as the heads become heavy, both varieties are likely to lodge and are then difficult to harvest. Lodging also causes serious losses in yield. Inasmuch as these varieties do not yield as well as the Dicklow, there is little to recommend them for use in southern Idaho.

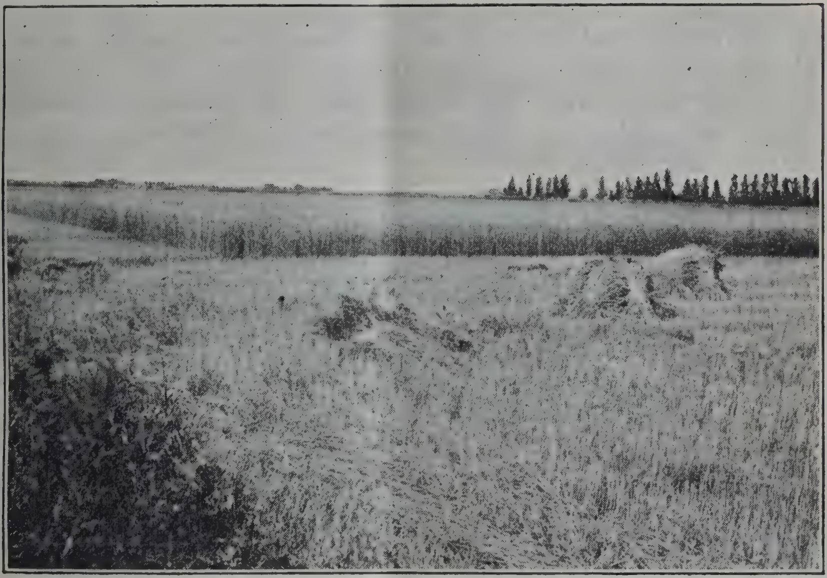


FIG. 10.—A field of pure Dicklow wheat which averaged 60 bushels to the acre.

The Marquis is a red spring wheat. In addition to being a lighter yielder than the Dicklow, the Marquis usually contains more or less yellow berry when grown under irrigation, and because of this it is docked on the market. Recent experiments, however, indicate that irrigation and climate are only partly responsible for yellow berry in red wheat. Investigation now points to the fact that irrigated land rich in nitrogen and amply supplied with other plant foods is capable of producing hard, red wheat high in protein content. The grain thus produced contains some yellow berry, but not nearly as much as red wheat produced on irrigated land which has not been fertilized or on land which has not grown a crop of alfalfa or clover.

OATS.

The experiments with oats have included 28 varieties during the 6-year period. Table II shows the yields of the 8 varieties which have been grown during five or six years. Many varieties were discarded as the tests progressed, while new varieties from the oat nursery were added as their merits warranted. Owing to insufficient area of land and the desire to replicate all varieties, many good varieties of oats were dropped in 1916. However, it is felt that the best varieties from all standpoints have been continued.

The Golden Rain, Early Mountain, and Silvermine have proved the best three varieties in the 6-year period. The same varieties also lead in the 5-year period, with Kherson a very close fourth. The Kherson has yielded remarkably well at Aberdeen, considering that it is an early oat. The Golden Rain is a midseason yellow oat, and the Silvermine and Early Mountain are midseason white varieties. The midseason varieties, on the average, have matured in 109 days from date of sowing. The early varieties, such as the Kherson, require only 102 days. The greatest seasonal variation was 25 days in the 6-year period.

TABLE II.—*Yields of oat varieties grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

Variety.	C. I. No.[1]	Yields per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average.	
								5 years, 1913 to 1917.	6 years, 1913 to 1918.
Golden Rain	493	126.2	98.8	153.5	111.0	110.6	90.6	120.0	115.1
Early Mountain	754	103.8	120.3	158.5	111.0	111.8	83.7	121.0	114.8
Silvermine	720	102.2	113.6	163.6	106.2	109.3	80.6	119.0	112.5
Kherson	723	88.7	110.0	160.2	119.2	116.2	70.6	118.9	110.8
Rustless selection	724	103.8	120.3	158.5	68.7	120.6	75.9	114.4	107.9
Swedish Select	134	104.2	97.1	163.6	93.7	102.5	75.6	112.2	106.0
Sixty-Day	165	103.0	101.4	161.9	98.5	90.6	....	111.1	....
Lincoln	756	73.1	115.6	163.6	96.2	98.1	....	109.2	....

[1] Cereal Investigations number.

Figure 11 shows the average acre yields, in bushels, of the six leading varieties of oats grown on irrigated land at the Aberdeen substation in the 6-year period from 1913 to 1918, inclusive.

The Swedish Select oat is the most prominent variety now grown in southern Idaho. It has a large, plump, white grain and a high bushel weight. It is of very good quality and the market takes it readily. The Swedish Select, however, has not yielded as well as several other varieties. The Golden Rain has averaged 9 bushels per acre more than the Swedish Select each year in the 6-year period. The Early Mountain has outyielded the Swedish Select by 8.7 bushels per acre. The Silvermine has outyielded it by 6.4 bushels per acre, and the Kherson has outyielded it by 4.7 bushels per acre in the 6-year period. The Kherson and Sixty-Day varieties have done very well. The Albion and Richland, white and yellow selections, respectively, from the Kherson, were substituted in 1918 for the Sixty-Day and Kherson varieties. The Kherson type of early oat seems well adapted to southern Idaho conditions and can well be used where desired as a nurse crop and at the high altitudes where the midseason varieties do not mature in time to avoid frost.

Oats are not particularly recommended as a nurse crop because of the dense shade produced. When it is necessary to use them for that purpose in order to obtain horse feed, the Kherson type of early oat is recommended. The rate of seeding should be reduced to not more than 5 pecks per acre of the Kherson variety, as the kernels ar small and feed faster in the drill than the larger seeded varieties.

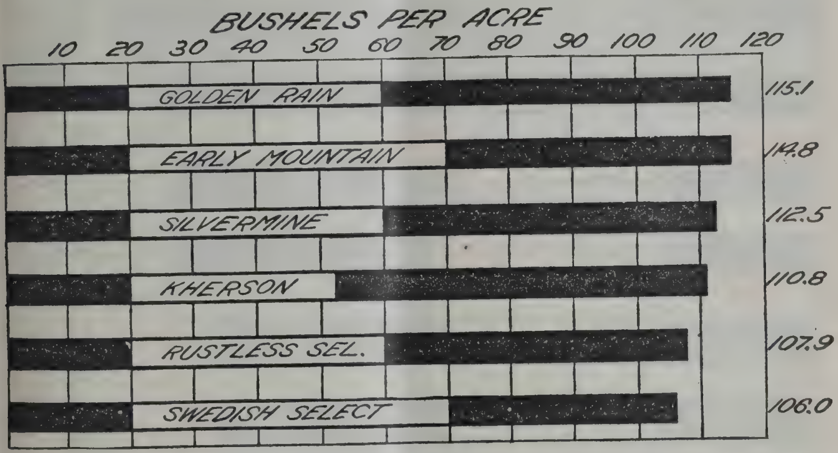


Fig. 11.—Diagram showing the average yields, in bushels per acre, of the six leading varieties of oats grown on irrigated land at the Aberdeen substation during the six years from 1913 to 1918, inclusive.

The best-yielding varieties of oats are all open panicled. The side oats, or so-called horse-mane oats, have never yielded as well as the open-panicled varieties. The grain from the side-oat varieties, while large, does not weigh as much per bushel as the grain of the open-panicled varieties, and the percentage of kernel to hull is not as high as it is in the open-panicled oat. The side oat has a very stiff straw which stands up well under irrigation, and seldom, if ever, grows as tall as that of the open-panicled oats. The great size and excellent appearance of the grain of the side oat have misled many people into sowing what really is an inferior variety for southern Idaho.

BARLEY.

The experiments with barley in the field plats under irrigation at the Aberdeen substation during the past six years have included 36 varieties. The yields of the seven leading varieties are given in Table III. These yields are shown graphically in figure 12.

Practically all varieties of barley do well in southern Idaho, as the yields clearly show. The Trebi is the most uniformly good variety for the irrigated lands of this section. It is a bearded 6-rowed barley which matures several days earlier than the Coast (California Feed), a variety now grown quite widely in southern Idaho. The head of the Trebi is longer and broader than that of the Coast variety, and the kernels are broader and not quite so long. The Trebi thrashes cleaner than the Coast, is lighter in color, and weighs more per bushel. The Trebi, in the five years it has been grown at Aberdeen, has exceeded all other varieties in average yield by 7.7 bushels an acre. The wonderful performance record of this splendid variety warrants its general use on the irrigated lands of southern Idaho. In most irrigated sections of the State, Trebi barley should be grown rather than other varieties. A field of this variety which averaged 97 bushels to the acre is shown in figure 13.

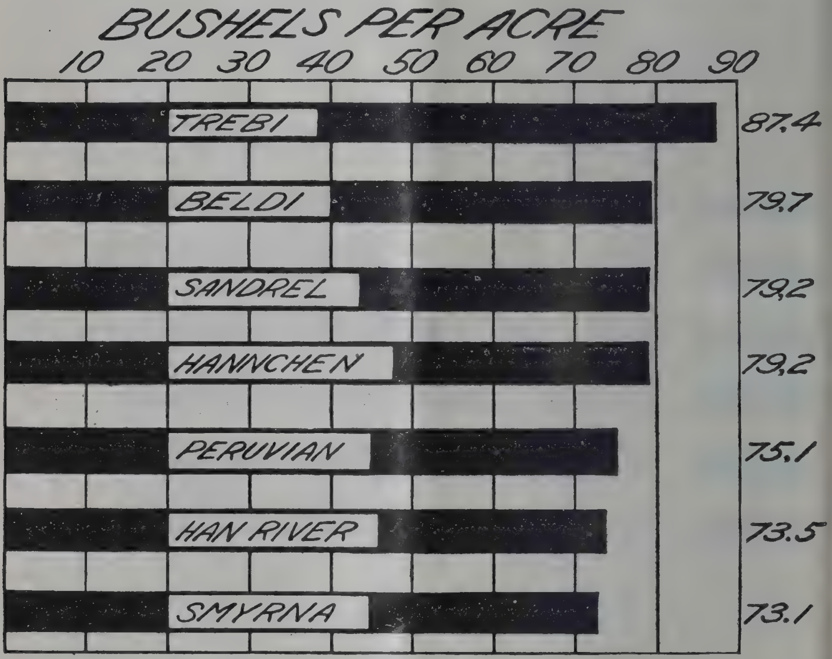


FIG. 12.—Diagram showing the average yields, in bushels per acre, of the leading barley varieties grown under irrigation at the Aberdeen substation during the six years from 1913 to 1918, inclusive.

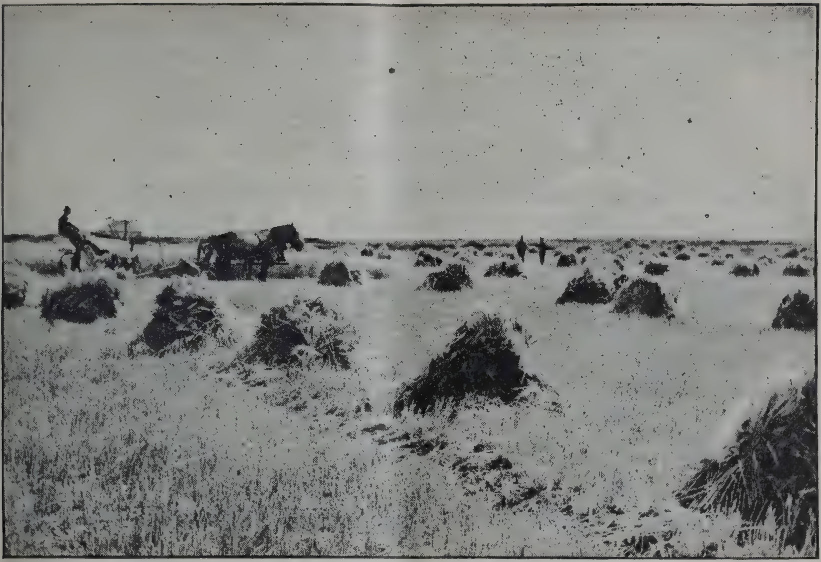


FIG. 13.—A field of Trebi barley on irrigated land which averaged 97 bushels to the acre.

ABLE III.—*Yields of seven leading varieties of barley grown on irrigated land at the Aberdeen substation during the 6-year period from 1913 to 1918, inclusive.*

he yields of all varieties, including those of the hull-less type, are figured on the basis of 48 pounds per bushel.]

Variety.	C. I. No.[1]	Yield per acre (bushels).							
		1913	1914	1915	1916	1917	1918	Average.	
								5 years, 1914 to 1918.	6 years, 1913 to 1918.
rebi	936	....	85.9	84.0	69.6	105.0	92.8	87.4	....
annchen	531	61.6	73.2	80.6	69.5	84.1	68.7	79.2	76.2
eldi	190	56.0	88.2	80.6	62.4	96.6	70.7	79.7	75.7
andrel	937	....	84.7	80.5	67.4	98.7	64.9	79.2	....
eruvian	935	....	74.4	84.0	74.9	87.9	54.5	75.1	....
an River	206	78.3	68.7	81.7	67.4	92.9	57.0	73.5	74.3
myrna	910	69.5	70.4	63.8	90.4	87.5	53.7	73.1	72.5

[1] Cereal Investigations number.

At the Aberdeen substation the hull-less and hooded (bald) barleys ave not approached the yield per acre, pound for pound, obtained from the hulled bearded barleys. A considerable acreage of hull-ess bald (Nepal) barley is grown in the upper Snake River basin, robably showing that these barleys are adapted to this section of he State. The 2-rowed barleys do well in southern Idaho, but have ot yielded as well as the Trebi. The Hannchen stands second in he list in yield per acre and the Smyrna stands seventh. The

Smyrna is an early dwarf variety with large, plump grains, but it is not able to yield in comparison with the other varieties.

HARVESTING AND THRASHING.

CUTTING.

The small grains should be cut before the grain is fully ripe. Wheat, oats, and barley shatter if not cut until fully ripe. When the grain has passed the hard-dough stage and is plump and glazed, it is ready to cut. If the crops are cut too early, shrinking of the kernel takes place, the kernel will not be plump and, as a rule, the weight per bushel will be lighter. In southern Idaho the warm, dry climate during midsummer hastens maturity. Where large areas must be cut with limited harvesting facilities, it often becomes necessary to cut part of the grain when somewhat green rather than lose some of the crop by shattering. Heavy windstorms often cause considerable loss from shattering in ripe grainfields.

CUTTING MACHINERY.

Binders, headers, and small combined harvesters, or combines, are used to cut the grain crops on irrigated lands in southern Idaho. The binder is used very extensively. The grain must be thoroughly ripe before the header or combine can be successfully used. On irrigated land where the grain is very thick and heavy it is hazardous to trust a well-matured grain crop to the weather, waiting two weeks for the grain to get ripe enough to harvest with a header or combine, when it can be cut with the binder and this great risk eliminated.

SHOCKING.

If the grain is cut somewhat green, only enough bundles should be put in one shock to make it firm. As a rule, the shocking process in southern Idaho is merely an assembling of bundles to facilitate loading for thrashing in the field or for stacking. Rain seldom falls during the harvesting period, and the care exercised in shocking grain in the humid areas is not required in southern Idaho. About 10 bundles make a good-sized shock. It is not necessary to cap shocks in this dry climate, and capping is often the source of considerable shattering, as the wind in the fall is occasionally strong enough to blow the cap bundles to the ground.

STACKING.

Thrashing from the field is an excellent way of saving time and a little labor. However, thrashing machines and crews must be plentiful to insure the work being done quickly and efficiently.

As a rule, stacking is far more satisfactory. When the grain is safely stacked the grower may exercise more care in the selection of his thrashing outfit. Grain always goes through a sweat, and it is better to have it go through the sweat in the stack than in the bin. If the weather should happen to be damp, grain thrashed from the field and binned at once is very likely to heat and mold.

The following excellent directions for stacking are given in Farmers' Bulletin 892, entitled "Spring Oat Production:"

> Stacking should be begun as soon as the grain is well cured in the shock, in about 10 days to two weeks after cutting. Round stacks are usually about 10 feet in diameter at the base. The usual plan is to build four stacks in a setting, in pairs 6 feet apart.
>
> First build a large round shock about 8 feet in diameter. Then place two layers of bundles, one directly on top of the other, with the heads resting against the shock and the butts forming the 10-foot base of the stack. Make the next row with the butts just covering the bands of the outer row. In the same manner lay rows of bundles, like shingles, until the center is reached, overlapping the rows a little more toward the center of the stack. When the first layer is completed, begin again at the outside and build toward the center.
>
> Shocked bundles have slanting butts, because they are set in the shock with a slight slant instead of exactly upright. In building the outside rows around the stack lay the long edge of the butt on top and projecting beyond the lower bundle. In this way the diameter of the stack is gradually increased, forming the bulge. After a height of 7 or 8 feet is reached, lay the outer bundles with the long edge of the butt beneath and just covering the inner edge of the layer just completed. In this way the diameter is gradually decreased and the stack is tapered slowly to a point.
>
> Always keep the middle of the stack high and firmly tramped down. Do not tramp the outer layer at all. Keeping the middle high gives all the bundles a slant toward the outside and helps to shed rain. At the peak, where the bundles overlap, fasten a capsheaf securely by setting it on a sharpened stake driven into the top of the stack. A well-built stack 10 feet in diameter should be 20 to 25 feet high.

THRASHING.

A great deal of careless thrashing is done in southern Idaho. The quantity of work done per day is the usual gauge of a job, rather than the quality of work done. Very little effort, if any, is made to clean out the separator before moves are made from farm to farm. Mixtures of all varieties grown are rapidly being made as a result of this practice. Much grain is wasted because canvases are not used under the machine. Far too much grain is being cracked, owing to the improper adjustment of the cylinder and concaves. The high speed of the cylinder usually will crack wheat, as will also side play of the cylinder. To thrash Dicklow wheat which is in a normal dry condition a speed of 900 revolutions per minute is ample. Good work can be done with as low as 750 if two bars of concaves are used. Trebi barley requires about the same speed of cylinder, while oats as a rule need a little more speed. If the grain is damp more speed is required to do a similar grade of work.

It is important that all cylinder teeth center between the concave teeth. If the cylinder teeth are to one side or the other, cracked grain is bound to result. Loose cylinder or concave teeth also will crack grain. The cylinder should be centered and all side play taken up before the boxings are permanently bolted.

Cracked grain will not grow, and it involves a useless waste which can easily be avoided. Thrashermen who do not know how to operate their outfits, so as to thrash and clean grain properly, should not be employed by the farmer. Dry grain thrashes cleaner and better than grain that is damp. Grain is often blown into the straw because the speed of the separator is too great. The farmer as a rule, however, gives more attention to the blow-over than he does to the cleaning of the grain or to the quantity of grain that is cracked or hulled. More care on the part of the farmer in connection with thrashing will result in greater profit and less trouble.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

UNITED STATES DEPARTMENT OF AGRICULTURE

1862 1889

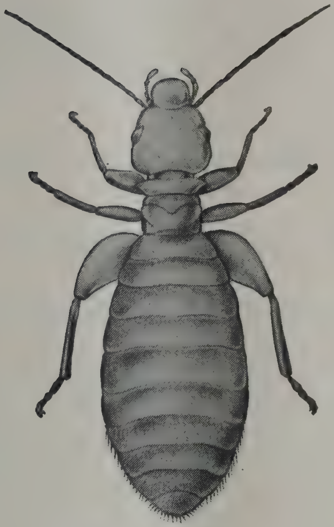
AGRICULTURE IS THE FOUNDATION OF MANUFACTURE AND COMMERCE

BOOK-LICE OR PSOCIDS

ANNOYING HOUSEHOLD PESTS

E. A. BACK

Entomologist in Charge of Stored Product and
Household Insect Investigations



Adult book-louse, about fifty times natural size.

FARMERS' BULLETIN 1104

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. February, 1920

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

BOOK-LICE, OR PSOCIDS, are the tiny white or grayish-white insects, scarcely as long as the width of an ordinary pinhead, and often much smaller, that scurry across the pages when old, musty books are opened.

They appear in houses in greatest numbers during late summer and early fall, and are more abundant in damp, well-shaded rooms not in general use, and in houses long closed. Very few are found in bright, sunny, dry rooms in constant use.

Book-lice run in a halting fashion over everything in the house. They feed on all sorts of vegetable and animal matter. It is not often that they become abundant, and when they do, they attract attention more by their annoying presence than by the actual damage caused. They injure man in no way and are therefore unlike the true lice.

Unless they are present in annoying numbers, it is probably not worth while to worry about book-lice, for many exist out of doors and can get in through cracks and through the mesh of ordinary screens. With the coming of cold weather, or in late fall and winter, book-lice die off, but may leave behind eggs that will hatch the following spring. Control measures, discussed on page 4, should be resorted to when book-lice become unusually abundant.

BOOK-LICE[1] OR PSOCIDS.

THEIR HABITS AND WHERE THEY THRIVE.

DWELLING HOUSES, libraries, museums, military barracks, storerooms, barns, and other buildings often harbor diminutive insects known as book-lice, or psocids. Although many of these doubtless enter from outside, those that become numerous enough to annoy occupants can live and multiply wholly within doors.

Book-lice are found in all sorts of places, such as the trunks and foliage of trees, on fences, in woodpiles, and in refuse of all sorts; in fact, upon practically anything that has been left undisturbed for any length of time during warm and moist weather.

The book-lice that occur in houses have no wings and are seldom one-sixteenth of an inch long, often much smaller. Their shape and appearance are shown by the figure on the title-page. They are pale colored, almost white when young, but as they grow older are darkened somewhat by the food they have eaten, for this shows through their more or less translucent bodies. When old, musty books are opened suddenly, the book-lice may be seen scurrying across the pages in a halting and uncertain fashion, and frequently they are noticed upon door screens, window panes, furniture, books, and photographs, or upon almost any object in the room.

Book-lice do not attack man as do the true lice, and are, therefore harmless to the occupants of a home. They are called book-lice

---

[1] Insects of the order Corrodentia and family Psocidae.

erely because they are often seen on books, and because they have
me resemblance to chicken lice. Usually they attract attention
ore because of their annoying presence than on account of the
tual damage they do. Ordinarily they are not regarded as in-
rious pests, yet they have jaws with which, in spite of their deli-
te structure, they can gnaw. They feed upon decaying timbers,
athers, straw, and hair, and upon flour, meal, and other farinaceous
bstances, and even dust. They eat the starchy paste in book bind-
gs, wall paper, and photographs. Indeed, they are general feeders
on dead and decaying animal and vegetable matter.

Book-lice thrive best in closed rooms that are warm and damp.
ldom are they noticed in light, airy rooms in constant use, but
ore often are found in numbers in darkened, damp parlors kept
osed except on special occasions, and in houses that have been
osed all summer. They die off during cold weather, but may
ave behind them eggs which hatch the following spring to furnish
e infestation for the succeeding year. Ordinarily they do not
come abundant enough to attract attention until late summer or
rly fall.

CONDITIONS FAVORABLE TO THEIR INCREASE.

As stated, book-lice are not especially injurious in dwelling houses,
rracks, or factories. It is only when materials which they are
pable of injuring, or in which they can breed, are left undisturbed
r long periods that they are likely to increase to such an extent
to cause serious damage or annoyance. Occasionally they multi-
y excessively in some available food supply, and swarm over a
use to the consternation of the housekeeper, but fortunately such
stances are rare. Upholstered furniture and mattresses stuffed
ith straw, husks, hair, feathers, or moss are specially favorable
aces for their multiplication, and in the worst cases of infestation
record, the psocids have come from such sources. They have been
und in myriads in straw in barns and stables, in the straw cover-
gs of wine bottles in cellars, and in rooms in which tow used in
e manufacture of upholstered furniture is kept.

One record on file indicates the usual history of infestation. In a
w house kept by very neat occupants, a mattress of hair and corn
sks which had been purchased not more than six months before
as found in a badly infested condition after the house had been
osed about six weeks.

It was so covered with psocids that a pin could not be stuck into the mattress
thout piercing an insect. The side of the sheet next to the mattress was
ewise covered, and a further search showed the walls and the entire house
be swarming with the tiny pests. A sweep of the hand over the walls
uld gather them by the thousands. Bureau drawers were swarming with

them, and they were on every object and in everything. The mattress wa found to contain millions of them, and seemed to be the source of the supply.

In a second case, newly purchased upholstered furniture became distributing point. When such excessive outbreaks of the pest occur in newly purchased mattresses and furniture, the cause beyon doubt is the use at the factory of unsterilized stuffings.

HOW TO CONTROL BOOK-LICE IN HOUSES.

Where only a few book-lice are present, a thorough cleaning, airing, and drying of the room is all that is needed, provided the sourc of infestation is within the room itself. As many as possible of th objects in the room should be removed and thoroughly sunned on bright day. The room should be heated to a temperature of 120 to 140° F. for several hours. Psocids are soft-bodied insects, an succumb to a prolonged drying due to heat. Where rooms ar located on the ground floor in loosely constructed buildings in shade and damp situations, as are many summer cottages, so many psocid come in from the outside that almost no treatment will entirely ri a room of them.

When book-lice swarm in alarming numbers over and throughou a room the breeding places should be located at once. If the sourc is old straw or husk fillings of mattresses, these should be remove and burned wherever possible. Thorough fumigation with the fume of sulphur,[1] 1 pound of sulphur being burned for each 1,000 cubi feet of space, is effective. Where other pests are present, such a bedbugs, and where the bleaching effects of the fumes can be disregarded, as in barracks, 5 pounds of sulphur will prove effectiv During fumigation the rooms should be kept closed as tightly a possible, and after five or six hours opened from without and thoroughly aired. Fumigation with hydrocyanic-acid gas is very effective, but dangerous in the hands of inexperienced persons. (Se Farmers' Bulletin 699.)

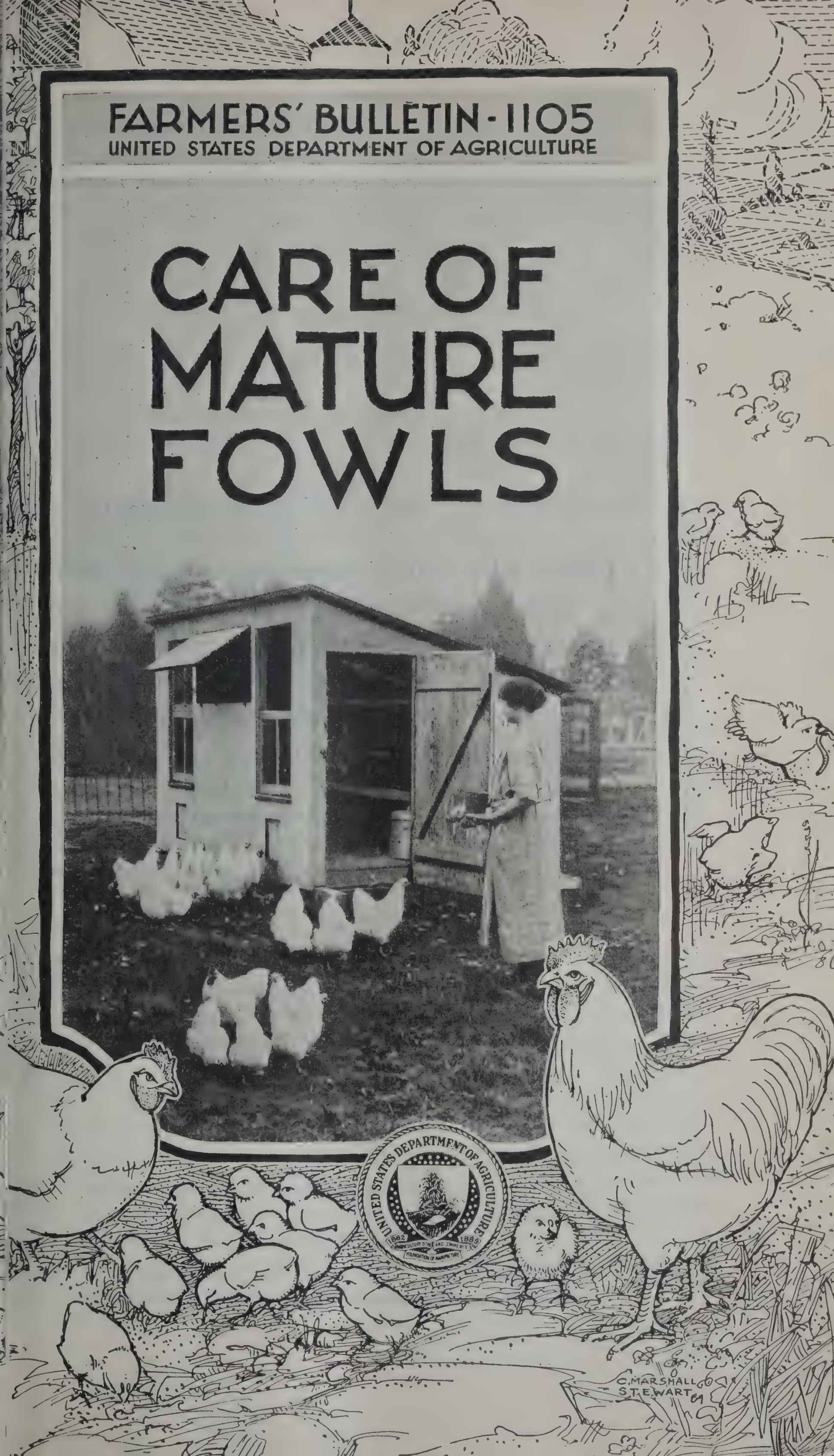
Closets, boxes, trunks, and sometimes even entire rooms, where infested objects are kept near the floor, can be fumigated satisfactoril with carbon disulphid. (See Farmers' Bulletin 799.) In additio to cleanliness and plenty of sunlight, heat or fumigation, whereve it can be applied, will yield the best results, if the source of infestation has been removed.

---

[1] Before resorting to sulphur fumigation the householder should be warned that sulph fumes can unite with moisture in the air to form sulphuric acid, thus having a bleac ing effect upon wall paper and other articles, as well as tarnishing metals of all sort The damper the house, the greater the bleaching. In houses thoroughly dried by he very little bleaching occurs. *Householders possessing homes furnished with rare valuable articles should never use sulphur.*

FARMERS' BULLETIN - 1105
UNITED STATES DEPARTMENT OF AGRICULTURE

CARE OF MATURE FOWLS



THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girl's Poultry Clubs. It points out the care which mature fowls should have in order to give best returns for the feed and attention they receive.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C.   Issued August, 1920; reprint, June, 1921

CARE OF MATURE FOWLS.

ALFRED R. LEE,
Animal Husbandry Division.

CONTENTS.

Page.
e of the poultry house.... 3
ding the hens.... 4
Egg-laying rations.... 4
How to feed.... 5
Green feeds, grit, and oyster shells.... 6
paring poultry and eggs for market.... 7

OULTRY-CLUB MEMBERS should get good returns from their hens, as a small flock of fowls will give excellent results they receive the proper feed and care, and the waste from the chen, table, and garden will help materially in keeping down the d bill. The henhouse should be thoroughly cleaned, disinfected, d made tight for the winter. See that the house is tight on three les and that there is no chance for a draft to strike the hens while their roosts.

Before putting pullets with old hens be sure that the birds hatched different years are banded or "toe-punched" so that you can tell e age of each one. Move the pullets into their winter quarters fore they begin to lay. All of them should be settled for the winter fore the weather gets cold. Market any pullets which are very all, poorly developed, or in poor condition.

CARE OF THE POULTRY HOUSE.

Keep the houses in good condition by cleaning the dropping boards least every other day, and spray or paint the roosts to destroy ites as advised in Farmers' Bulletin 1110 on "Lice, Mites, and eanliness." Keep a supply of sand, dry dirt, or coal ashes on hand use on the dropping boards. Provide 3 or 4 inches of clean litter straw or leaves on the floor of the house, and scatter the grain in e litter during the winter to make the hens exercise for their feed. e or two inches of clean straw, chaff, or shavings should always kept in the nests so that the eggs will be kept clean and not be oken. Plenty of sunlight and proper ventilation will help keep e fowls healthy and the house clean and sweet.

Whenever you feed the hens be sure that they are all active and althy and remove any that are sick or out of condition. Always have some ventilation to keep the air thoroughly dry in the house both day and night. Ventilation is controlled by regulating the windows or muslin curtains in the front of the house according to th weather conditions.

FEEDING THE HENS.

Feeding hens is one of the most important factors in producin eggs. Properly balanced palatable feeds are necessary to get goo egg production. Corn, wheat, and oats are the principal grains fe to poultry and make what is called the scratch mixture. In additio to the scratch mixture the hens should be fed a mixture of groun grains, mill products, and meat scrap or milk, which constitute mash. Corn meal, wheat bran, wheat middlings, ground oats, an meat scrap form the basis of a good mash. to which other product may be added if available at a low price. Use at least two grain in the scratch mixture, selecting those grown at home or produce locally, and supplement these with corn meal, mill feeds, and mea scrap or waste milk. The club member who keeps only a few hen and does not live on a farm or produce any grains will often find i advantageous to buy the prepared scratch mixtures and mashes.

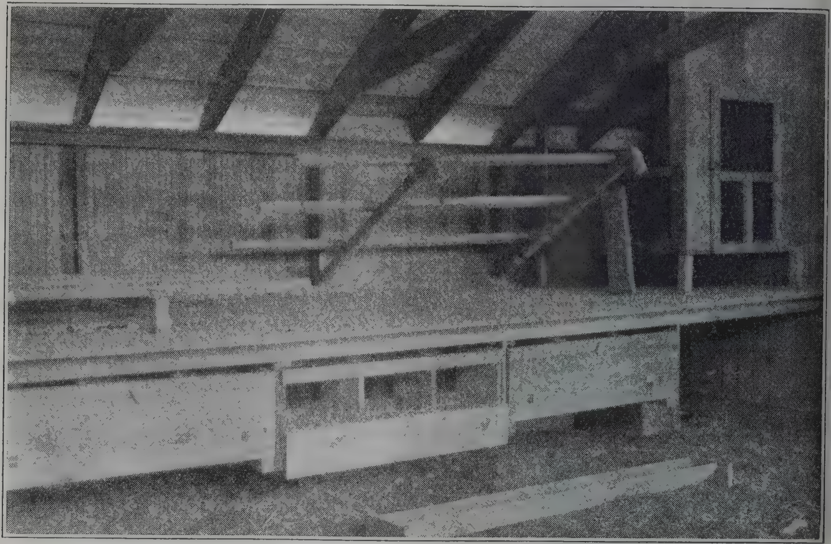


FIG. 1.—Interior of pen showing one roost raised to clean dropping board. Nests contain clean straw an floor is covered with clean litter. The feed trough is used for a moist mash.

EGG-LAYING RATIONS.

The following rations have been used with good results on th Government experiment farm at Beltsville, Md.:

Ration No. 1.

Mash.	Scratch mixture.
2 pounds corn meal or barley meal.	2 pounds cracked corn.
1 pound bran.	1 pound oats.
1 pound middlings.	1 pound wheat or barley.
1 pound meat or fish scrap.	

Ration No. 2.

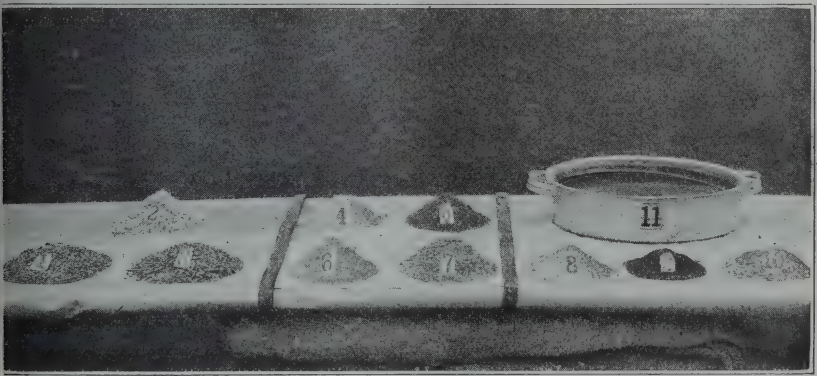
3 pounds corn meal.	2 pounds cracked corn.
1 pound meat scrap.	1 pound oats.

Ration No. 3.

3 pounds corn meal.	2 pounds cracked corn.
1 pound bran.	1 pound wheat.
1 pound middlings.	1 pound oats.
½ pound meat scrap.	

Feed with table scraps or cooked vegetables.

Ration No. 3 is of especial value to club members who have a nsiderable quantity of waste products from the kitchen, tables,



G. 2.—Feeds used to make a balanced egg-laying ration: (1) wheat, (2) cracked corn, (3) oats, which make up the scratch feed; (4) corn meal, (5) meat scrap, (6) middlings, (7) bran, which make the mash, (8) grit, (9) charcoal, (10) oyster shell and water. These last four materials should be kept before the hens constantly.

r garden. If skim milk or buttermilk is available this mash can be ixed with milk and the meat scrap omitted.

HOW TO FEED.

The scratch mixture should be fed twice daily, preferably in litter om 3 to 5 inches deep on the floor of the henhouse. Feed about ne-third of the mixture in the morning and two-thirds in the afteroon. In the morning give only what the fowls will eat up within alf an hour, and at night enough to satisfy them fully.

Feed a mash either as a dry or moist feed in addition to the scratch rains. The dry mash is the more common method. It should be kept in a hopper before the fowls constantly. A moist (not sloppy) mash gives very good results when used by a careful feeder. It should be fed only once a day, preferably in the morning or at noon, and only as much should be fed as the fowls will clean up in from 15 to 30 minutes. A moist mash is very useful to use up table scraps and cooked vegetables, and is greatly improved if mixed with milk.

The boys and girls must use their own judgment in deciding how much grain to give the hens, as the quantity of feed they will eat varies with different pens and at different seasons of the year. A fair general estimate is to feed about 1 quart of scratch grains and an equal weight of mash (about 1½ quarts) daily to 13 hens of the general-purpose breeds, such as the Plymouth Rocks, Rhode Island Reds, or Wyandottes, or to 16 hens of the smaller or egg breeds.

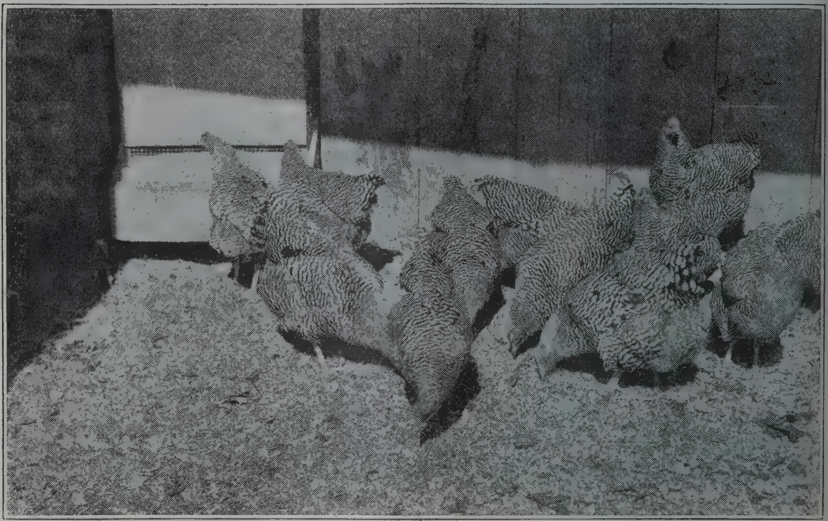


FIG. 3.—Flock of laying hens scratching for their grain. This gives the necessary exercise to keep the hens in good condition. The feed hopper hung up in the left-hand corner of the pen is kept filled with dry mash.

This would be about 7½ pounds each of scratch grains and of mash daily to 100 Leghorns and about 9½ pounds of each to 100 general-purpose fowls. If hens have free range or large yards containing green feed a general-purpose hen will eat about 75 pounds of feed in a year and a Leghorn will eat about 55 pounds, in addition to the green stuff consumed.

GREEN FEEDS, GRIT, AND OYSTER SHELLS.

Green feeds should be supplied to hens confined in small yards and also to all hens during the winter, when no green feed is available in the yards. Free range or large yards kept in grass will furnish ideal conditions for green feed. Where smaller yards have to be used they should be divided into 2 parts and used alternately, plant-ig the vacant section two or three times yearly with a quick-growing reen crop, such as rape, oats, wheat, rye, or barley. This method rnishes green feed and also helps to keep the yards sweet and ean, which is a very important consideration.

Good kinds of green feeds are sprouted oats, alfalfa meal, chopped falfa and clover hay, cabbages, and mangel beets. Cabbages ay be hung up in the poultry house; the beets are usually split nd stuck on a nail on the side wall of the pen about a foot above e floor. Clover and alfalfa may be fed as hay cut into ¼ or ½ inch ngths, or they may be bought in the form of meal.

Oats for sprouting are soaked overnight in warm water and then read out from ½ to 1 inch thick on trays having perforated bottoms nd put into an oat sprouter. Water the oats thoroughly and turn e trays around once daily to promote even sprouting. Artificial eat should be supplied in cool weather by the use of a kerosene mp or by some other means. Use a good grade of oats, allow a quare inch of sprouted-oat surface per hen daily, and feed these routed oats on the floor of the poultry house or in the yard. Feed t any time after the sprouts are well started, which usually takes om 5 to 7 days. Keep the sprouter clean and spray it occasionally ith disinfectant to prevent the growth of mold.

Keep oyster shells, grit, charcoal, and plenty of clean drinking ater before the hens all the time.

PREPARING POULTRY AND EGGS FOR MARKET.

Care should be used to put the dressed poultry and eggs in first-lass condition, whether they are used in the home or marketed lsewhere.

The eggs should be gathered daily, kept in a cool, dry place, and arketed at least twice a week. Eggs to be used for hatching hould be collected two or three times daily in very cold weather to revent chilling. When the eggs are not to be used for hatching, is better to produce infertile eggs, as they keep better than fertile ggs in warm weather. If the club member has eggs enough they hould be sorted and packed in dozen cartons, according to their olor and size. Any soiled eggs should be cleaned by wiping with a amp cloth.

Cockerels which are not to be saved for breeders should be mareted, either as broilers or roasters, as soon as they are large enough. Iens should be culled and marketed according to their age and ondition, as discussed in Farmers' Bulletin 1112 on "Culling for ggs and Market."

Birds which are to be killed and marketed should be kept withut feed for at least 12 hours before killing. The best method of killing is to suspend the fowl by the legs and through the mouth cut the jugular vein in the back of the throat with a sharp-pointed knife. After crosscutting this vein once or twice cut into the roof of the mouth so as to pierce the brain with the point of the knife, slightly turning the point after it has pierced the brain. Fowls to be used at home may be more easily killed by chopping off their heads. The fowls may be either dry picked or scalded. Dry picking makes a better-appearing market fowl, but scalding, which is easier, is often preferred, if the bird is for home use. Dry picking should be done immediately after the bird is killed, as the feathers will then come out more easily. Be careful not to tear the skin.

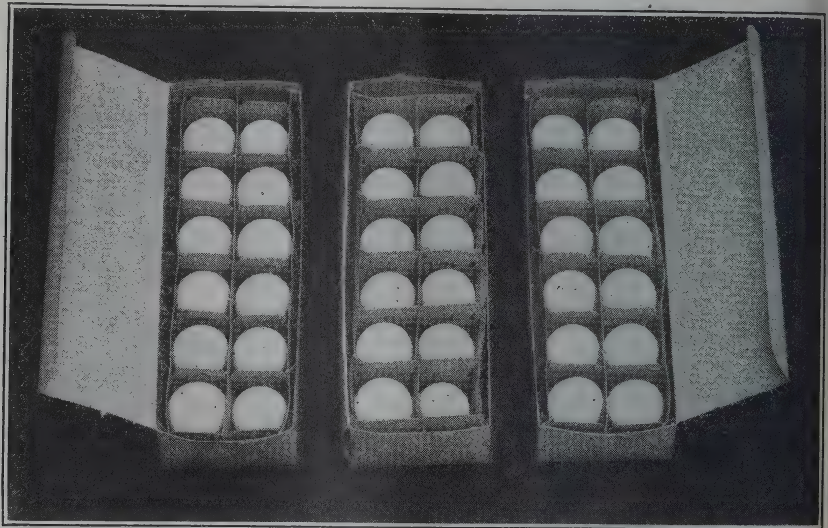


FIG. 4.—Uniform products command the best prices. Standardbred fowls produce uniform products.

For scalding use water which is just below the boiling point, immersing the fowl two or three times in the water, or until the feathers will pull off easily, but do not leave it in so long that the skin will scald.

Cool the fowls after they are picked, either by hanging them up in a cool place or soaking them in cold or ice water. Fowls for market are usually sold undrawn, but for home or local use they may be drawn by removing the crop through an opening made in the skin of the neck, and cutting around the vent and then removing the intestines and all other visceral material, making an additional slit into the abdomen if necessary. Place the liver and gizzard back in the body cavity.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1921

FARMERS' BULLETIN·1106
UNITED STATES DEPARTMENT OF AGRICULTURE

INCUBATION OF HENS' EGGS

MOST BOYS AND GIRLS when joining a poultry club begin their work on a small scale by carrying on their hatching operations with sitting hens. Accordingly, the directions in this bulletin are given for the use of beginners or those wishing to hatch eggs by the natural method.

For information on the artificial incubation of eggs, as well as for additional and more complete information on natural incubation, the reader should ask for Farmers' Bulletin 585, "Natural and Artificial Incubation of Hens' Eggs," which may be obtained in many cases from local club agents or will be sent free of charge on application to the Division of Publications, United States Department of Agriculture, Washington, D. C.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. September, 1920

INCUBATION OF HENS' EGGS.

Harry M. Lamon,
Senior Poultryman, Animal Husbandry Division.

CONTENTS.

	Page.		Page.
lection of eggs for hatching	3	Care of the sitting hen	5
sts for sitting hens	3	Method of testing eggs	6
w to set a hen	4	Hatching	8

SELECTION OF EGGS FOR HATCHING.

FERTILE EGGS from vigorous breeding stock are necessary in order to obtain good hatches. The best eggs for hatching are btained from stock which is properly mated and managed. Free nge for the breeders is most desirable for the production of fertile ggs with vigorous germs, and, if possible, members of poultry clubs hould give their breeders free range rather than keep them yarded.

Eggs that are abnormally small and poorly shaped should not be sed for incubation; neither should eggs that have thin or very orous shells. If possible, eggs should be set when fresh, and it is ever advisable to use for hatching eggs that are more than two eeks old. One of the quickest ways to obtain uniformity in the ffspring is to select uniformly good-sized eggs of the same color. irty eggs or those badly soiled should not be used. Those slightly oiled, however, may be cleaned by rubbing lightly with a damp loth, care being taken not to rub off any more of the natural bloom f the egg than is necessary.

In freezing weather eggs for hatching should be collected two or hree times a day so as to prevent their being chilled. Broody ens allowed to sit on eggs in the nest for any considerable time are pt to hurt the hatching qualities of the eggs by causing partial ncubation. Neither a hen nor an incubator will hatch strong chicks rom eggs containing weak germs or from those which have not eceived proper care.

NESTS FOR SITTING HENS.

When only a few hens are to be set, boys and girls will not find it necessary to provide separate quarters for the sitting hens. Of the arious styles of nests for sitting hens the following is recommended: The nests should be 15 inches square, 15 inches high in back and ides, and with a board 6 inches high in front to prevent the nesting material from falling out.

Before placing the nesting material in the nest proper it is well to put from 3 to 4 inches of damp earth or a piece of grass sod in the bottom of the nest to provide moisture. The nesting material, which may consist of hay, chaff, or straw, is then put in. Pack the nesting material down firmly and shape a circular nest slightly deeper in the center than at the edges. A nest so shaped will prevent the eggs from rolling out from under the hen and becoming chilled.

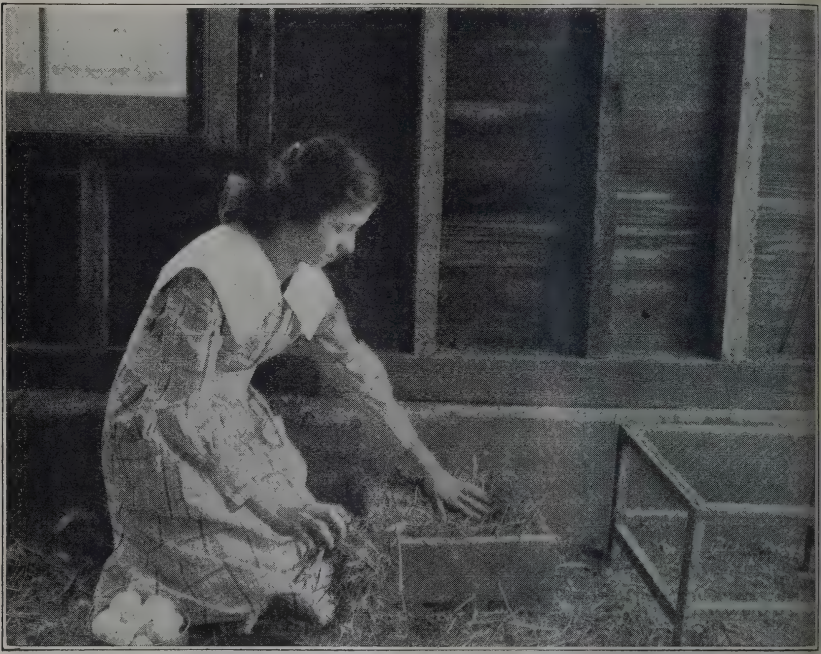


FIG. 1.—Making a nest for the sitting hen.

HOW TO SET A HEN.

There are several ways to tell when a hen is becoming broody and wants to sit. Look into the nest and in all probability it will be seen that a few soft, downy feathers have been left there by the hen, and also that she remains on the nest longer when laying. Again on being approached she will remain on the nest, making a clucking noise and ruffling her feathers. When one is reasonably sure that the hen is broody, and her breast feels warm to the hand, she is ready to be transferred to the nest where she is to sit and which should have been previously prepared.

At this time it is advisable to dust the hen thoroughly with insect powder. In doing so hold the hen by the feet with the head down working the powder well into the feathers, especially those around the vent and under the wings. The sitting hen should be dusted again on or about the eighteenth day of incubation so as to be sure that there are no lice present when the chicks are hatched. Powder should also be sprinkled in the nest. Sodium fluorid may be used under the directions given in Farmers' Bulletin 1110.

When possible the nest should be in some out-of-the-way place ere the hen will not be disturbed. Move the hen at night from the gular laying nest to the nest where she is to sit, and in doing so ndle her carefully. Place a china nest egg or two in the nest where e is to sit, and place over the nest a board or a covering such as that own in figure 3, so that the hen will not get off. Toward the end f the second day go quietly to where the hen is sitting, leave some ed and water, and remove the covering from the top or front of he nest, so that she can come off when ready. The best feed for he sitting hen is whole corn or wheat, or both. Should she return o the nest after feeding, remove the china egg or eggs and place n the nest the eggs that are to be incubated. The nest should be lightly darkened, as the hen is then not so likely to become restless.

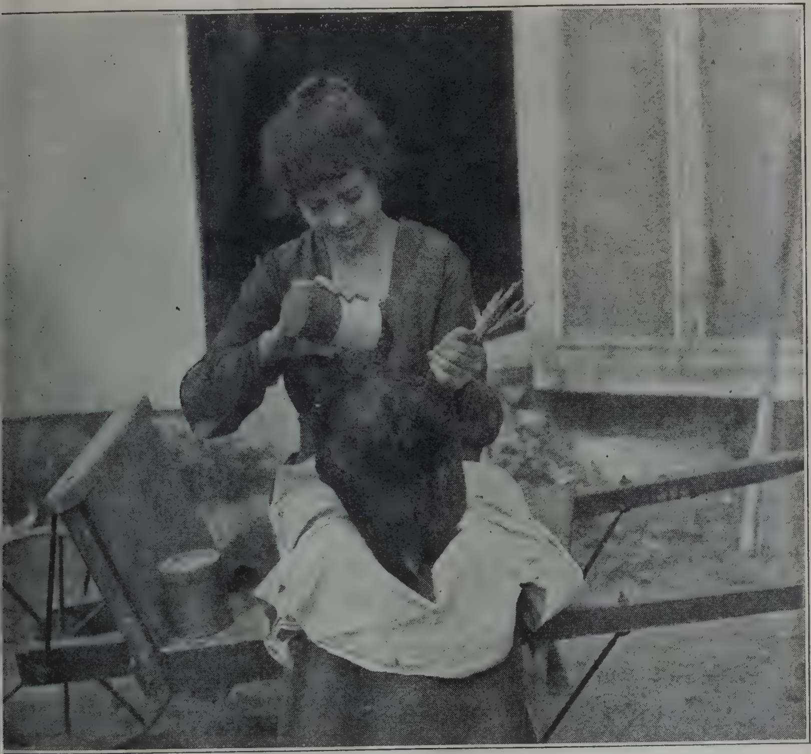


FIG. 2.—Dusting the sitting hen with insect powder.

In cool weather it is best not to put more than 10 eggs under a hen. ater in the spring, however, from 12 to 15 eggs can be set, according o the size of the hen.

CARE OF THE SITTING HEN.

When several hens are sitting in the same room they should be ept on the nests, only allowing them to come off once each day to eceive feed and water. If there are any that do not voluntarily come off the nests they should be taken off. As a rule hens will return to their nests before there is any danger of the eggs chilling, but if they do not go back in half an hour they should be put back.

Boys and girls are advised to examine and clean the nests carefully, when necessary removing all broken eggs and washing those that are soiled. When nesting material is soiled by broken eggs it should be replaced with clean straw, hay, or chaff. Nests in which eggs become broken soon become infested with mites and lice, which will cause the hens to become uneasy and leave the nest. This is likely to be the cause of the loss of valuable sittings of eggs. When a nest is infested with mites the hen, if fastened in, will often be found standing over rather than sitting on the eggs.

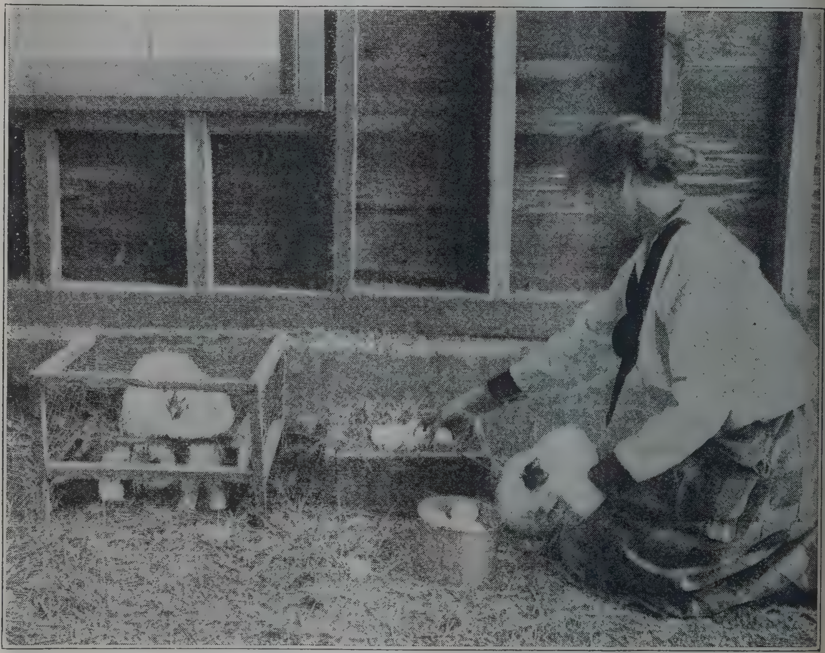
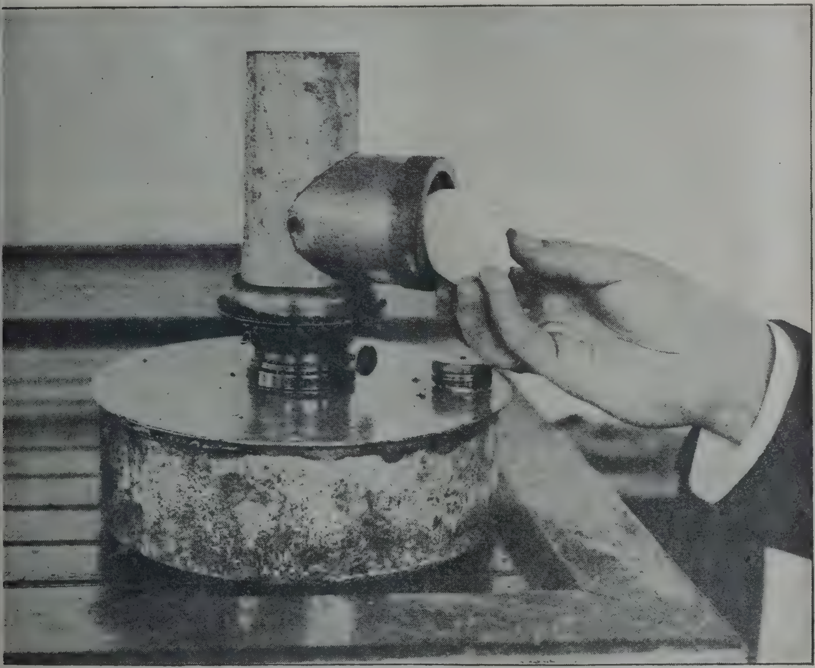


FIG. 3.—Placing the eggs in the nest for the sitting hen.

Frequently eggs that are laid late in winter or early in spring are infertile, and for that reason it is advisable to set several hens at the same time. After the eggs have been incubated for from five to seven days, the time depending somewhat on the color and thickness of the shells, they should be tested, the infertile and dead-germ eggs removed and the fertile eggs returned to the hens. Thus in many cases all the eggs remaining under several hens may be placed under one or two, and the hens from which the eggs were taken may be reset. For instance, 30 eggs are set under 3 hens at the same time; that is, 10 under each hen. At the end of 7 days, at which time the eggs should be tested, it may be found that 10 are infertile or have ad germs, leaving only 20 fertile eggs. These 20 eggs can then be ut under two hens, and a new sitting placed under the third hen.

METHOD OF TESTING EGGS.

All members of the poultry clubs should be thoroughly familiar ith the method of testing eggs. An egg, whether fertile or not, as a small grayish spot, known as the germinal spot, on the surface the yolk. As soon as a fertile egg is placed under a hen or in an cubator the development of the germ begins. Test all eggs at ast twice during the incubation period, preferably on the seventh nd fourteenth days. The infertile eggs and those with dead germs hould then be removed. White-shelled eggs can be tested on the urth or fifth day, whereas the development in eggs having brown hells often can not be seen by the use of an ordinary egg tester until he seventh day.



G. 4.—Testing an egg by the use of a metal-chimney tester which usually comes with an incubator or which can be purchased from poultry-supply houses. Such a tester can be readily fitted on an incubator lamp.

A satisfactory homemade egg tester or candler can be made with a hoe box or any other box that is large enough to hold a lamp. Cut a ole a little larger than the size of a quarter in the side of the box, o that when the lamp is placed inside the box the hole in the side ill be opposite the flame. A hole should also be made in the op of the box large enough to prevent the top from catching re from the heat of the lamp. If the chimney is long enough it hould be allowed to extend through the top of the box, to allow the heat to escape and to avoid the risk of fire. Special care should always be exercised in using kerosene lamps to prevent fire. To prevent further possibility of fire, a wooden box may be used in place of a pasteboard one, and if desired, the opening through which the chimney extends may be lined with tin or some fireproof material.

Electric or gas lamps may be used in a box with a hole, slightly smaller than an egg, cut in the side of the box and at the same level as the light. The eggs may also be tested by sunlight or daylight, using a shutter or a curtain with a small hole in it for the light to shine through.

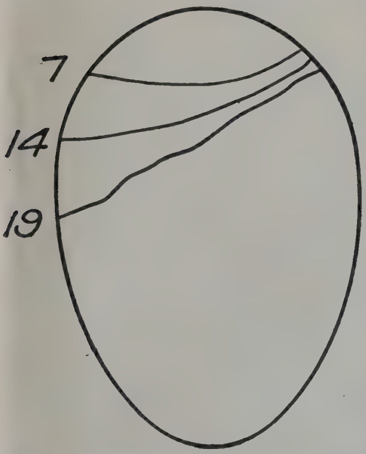


FIG. 5.—Diagram showing the air cell of a egg on the seventh, fourteenth, and nineteenth days of incubation.

The testing should be done in a dark room. To test the eggs, hold each egg with the large end up, so that the size of the air cell may be seen (see fig. 5), as well as the condition of the embryo or germ. An infertile egg when candled looks perfectly clear, the same as a fresh one, while a fertile egg shows a dark spot, known as the embryo, with a mass of little blood veins radiating in all directions. If the germ is dead and the egg has been incubated for at least 48 hours the blood settles away from the embryo toward the edges o the yolk, forming in some cases an irregular circle of blood known as a blood ring. Eggs vary in this respect, some showing only a streak of blood.

All infertile eggs and those with dead germs should be removed a the first test. Eggs with dead germs soon decay and give off a bac odor if allowed to remain. Infertile eggs make good feed for youn chickens (see Farmers' Bulletin 1108).

At the second test (on the fourteenth day) the eggs containin strong, living embryos will be dark and well filled up, showing clear, sharp, distinct line between the air cell and the growing embryo while eggs with dead germs will show only partial development an lack this clear, distinct outline.

HATCHING.

The period of incubation for hens' eggs is 21 days. Usually som of the eggs hatch in the evening of the twentieth day; it sometime happens, however, that the hatch will run over the twenty-first day especially during cool weather.

When the eggs begin to hatch, the hen should be confined and nc disturbed until the hatching is complete unless she becomes restles In such case it is best to remove the chicks which have been hatche and keep them in some warm place until the hatch is complete Then return all the chicks to the mother.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 19

FARMERS' BULLETIN·1107
UNITED STATES DEPARTMENT OF AGRICULTURE

BROOD COOPS AND APPLIANCES

THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs.

Poultry-club members are successful when they give their birds good care. Fowls of all kinds, both young and mature, will thrive and yield a profit when given proper care and attention.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. October, 1920

BROOD COOPS AND APPLIANCES.

D. M. Green,
Animal Husbandry Division.

CONTENTS.

	Page.		Page.
od coops for hen and chicks	3	Dry-mash hopper	7
p for shipping exhibition fowls	5	Drinking fountain	7
hibition coop	6		

BROOD COOPS FOR HEN AND CHICKS.

EVERY boy and girl club member should provide a good coop for the mother hen and little chickens. If you do not have one ready, it should be built before it is time for the little chicks to tch. Many boys and girls build their coops in the wintertime so s to have them ready for use in the spring, and when this is done a est box can be placed in the coop and used for the sitting hen. A roperly constructed coop is a good place for hatching chickens as

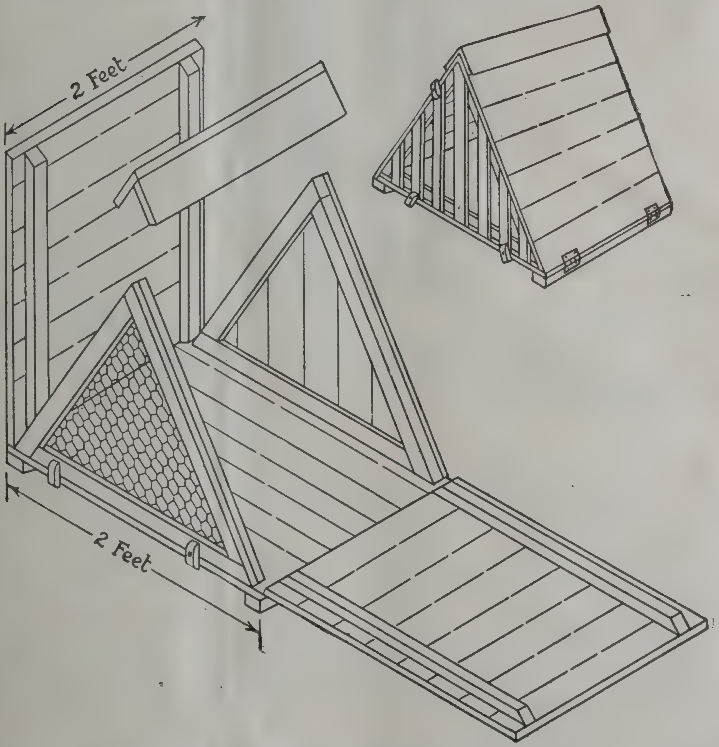


Fig. 1.—"A"-shaped brood coop for hen and chickens.

well as for brooding them. When chickens are hatched in the bro
coop, however, the nest should be removed and the coop thorougl
cleaned and disinfected before putting the hen in with her chicke

The two brood-coops ("A" shaped and box coop as illustrated
figs. 1 and 2) can be made easily from dry-goods boxes or otl
available material. The "A"-shaped coop, as shown in the illust
tion on page 3, is collapsible so that it can be easily cleaned or stor
away in winter. Or if desirable, it may be built stationary

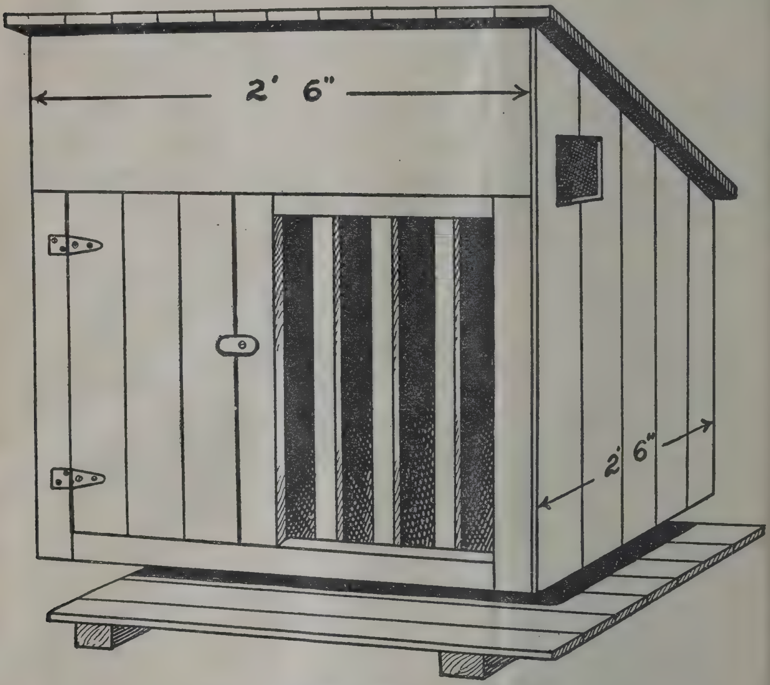


FIG. 2.—Box brood coop for hen and chicks.

simply nailing fast the top, back, and slats in front and placing it
a removable bottom. A wire-screen door (1-inch mesh or smalle
of some sort should be provided, as shown in the illustration of tl
collapsible coop (fig. 1), to place over the front at night. This w
prevent rats and other enemies from entering the coop and killir
the chickens, and will also keep the little chicks confined early in tl
morning, when the grass is wet. A hook or clasp should be put
the door to hold it firmly in place.

The mother hen should be confined to the brood coop until tl
chicks are weaned. This will give the little chicks a better start
life and prevent loss from storms, hawks, etc.

Floors should be constructed for the brood coops to rest on. Th
will keep the chickens dry, and if kept clean and well disinfected
will prevent losses from disease. It is a good plan to keep some dr

nd or chaff on the floor under the coop. This helps to keep the op dry and makes cleaning easy.

To make brood coops rain-proof, cover all cracks on the top, back, d sides with strips of wood or tin, or, better still, cover with roofing per. Construct the brood coop so well that it can be used year ter year.

COOP FOR SHIPPING EXHIBITION FOWLS.

Club members who wish to ship their fowls by express and have em arrive in the best possible condition will want a special shipping op like that shown in figure 3. Such a coop is solid and substantial d will last for a long ne. It may be made om boards taken from y-goods boxes or almost ny other half-inch mate- al. Boards more than e-half inch thick should t be used, as they make e coop too heavy. The op may be put together ith nails, with the excep- on of the slats or cover n the top, which should put on with screws or nges and hooks so that may be easily opened. his is very important, as e top or cover must be pened each time the coop used, and if put on with ails it is soon broken nd the coop spoiled. The following dimensions should be used in nstructing the coop:

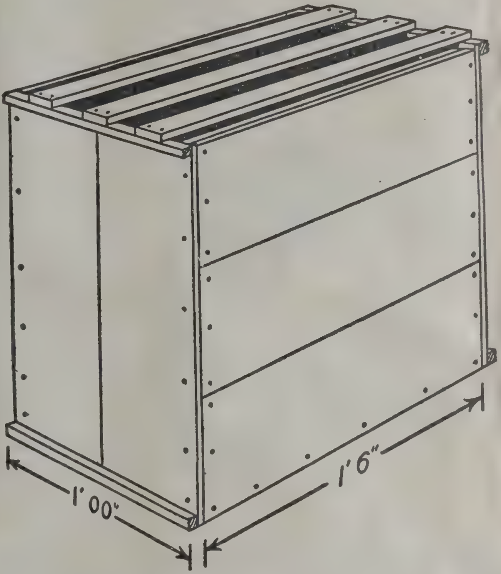


FIG. 3.—Coop for shipping exhibition fowls.

For one hen or cock—12 inches wide, 18 inches long, and 24 inches igh.

For two hens or hen and cock—12 inches wide, 24 inches long, and 4 inches high.

For a trio or two hens and one cock—18 inches wide, 24 inches long, nd 24 inches high.

For an exhibition pen or four hens and cock—24 inches wide, 24 ches long, and 24 inches high.

In preparing for shipment a small quantity of hay, straw, or dry havings should be placed in the bottom of the coop to absorb the oisture, and two cups or cans provided, one for feed and one for ater. The cans should be nailed securely to the side walls in opposite corners, about halfway to the top of the coop. A tag or car plainly marked, showing the destination of the shipment as well a the return address, must be tacked or pasted on the outside where i can be plainly seen.

EXHIBITION COOP.

The exhibition or show coop illustrated in figure 4 can be easil made and is for the use of poultry-club members in exhibiting fowl at county and school fairs or other exhibitions. It should not b

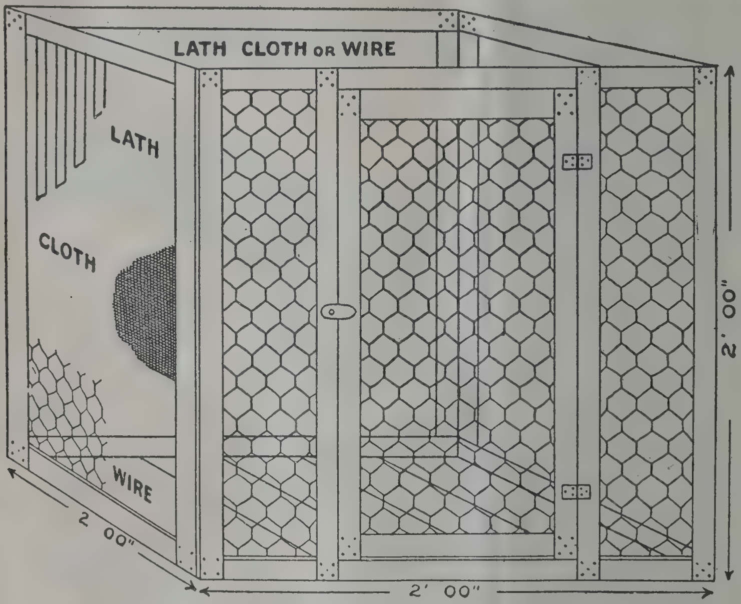


FIG. 4.—Homemade exhibition coop.

used for shipping poultry, but may be used to take the birds to th show if carried by wagon or other vehicle. It can be made from dry-goods box or almost any other available material. The floo should be solid and the framework of wooden strips 2 inches wid and 1½ inches thick. The top, back, and sides may be covered wit lath, wire netting, or any kind of thin, strong cloth. The fron should be of 2-inch wire netting. If it is impossible to obtai netting, however, lath may be used, but the strips should be place about 2½ inches apart so as to afford as much opportunity as possibl to see the birds. The coop is made 2 feet wide, 2 feet deep, and feet high, and will accommodate one mature bird or a pair of chickens. If more than this are to be exhibited together, the coop should b made larger in proportion to the number of fowls it is to accommodate.

Every poultry-club member who intends to exhibit his birds shoul have one or more exhibition coops of this nature, depending upon th number of specimens he intends to exhibit. Birds can be trained and nditioned in these coops before the exhibition, and after becoming customed to them they will appear to better advantage when being dged and are more likely to win a prize. Furthermore, when birds e shown in coops of this kind that are uniform in size and style, not ly is the appearance of the showroom improved but the individual hibit is much more attractive.

Training and exhibiting some of the best specimens of both old d young birds every fall is an interesting and important part of ys' and girls' poultry-club work. The boy or girl who is able to oduce the best has much to be proud of, and each one should take art in this educational but friendly competition.

DRY-MASH HOPPER.

The dry-mash hopper (fig. 5) is tended for use inside the laying ouse. It should be hung against e wall about 8 or 10 inches from e floor, or as high as possible so ng as the fowls can reach the ash. This prevents the mash om being thrown out and wasted. may be made from boards ken from dry-goods boxes or ther thin material. There are ree compartments—one for grit, ne for shell, and one for dry ash. The projections from the artitions are to prevent the fowls om mixing the dry mash with he grit and shell, as well as from asting it. The feeding of dry mash is a better practice than eeding wet or moist mash, as it requires less work and the hens can egulate their feed to suit their needs.

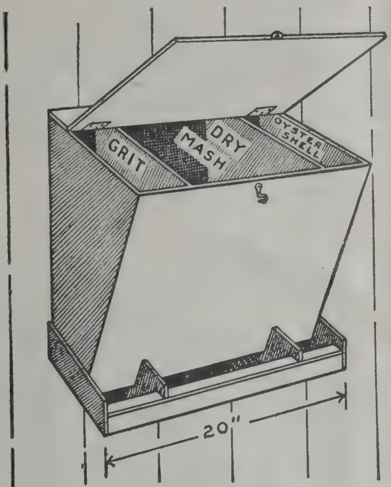


Fig. 5.—Dry-mash hopper.

DRINKING FOUNTAIN.

A satisfactory way to provide drinking water is to use an ordinary tone, iron, or galvanized dish, pot, or crock (the size depending upon he number of birds), placing it on a shelf or platform high enough rom the floor to prevent the fowls from scratching litter, etc., into it.

Various styles of drinking fountains for both fowls and chicks can e purchased from poultry-supply dealers.

FARMERS' BULLETINS SPECIALLY USEFUL FOR MEMBERS OF BOYS AND GIRLS' POULTRY CLUBS.

1106. Incubation of Hens' Eggs.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1110. Lice, Mites, and Cleanliness.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.
1116. The Selection and Care of Poultry Breeding Stock.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.
585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
656. The Community Egg Circle.
682. A Simple Trap Nest for Poultry.
684. Squab Raising.
697. Duck Raising.
767. Goose Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continental Class
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and French Class
1067. Feeding Hens for Egg Production.

Bureau of Chemistry Circular 61, revised, How to Kill and Bleed Market Poultry.

For copies of these bulletins or further information on poultry raising, write to yo poultry-club leader, or to the Animal Husbandry Division, Bureau of Animal I dustry,

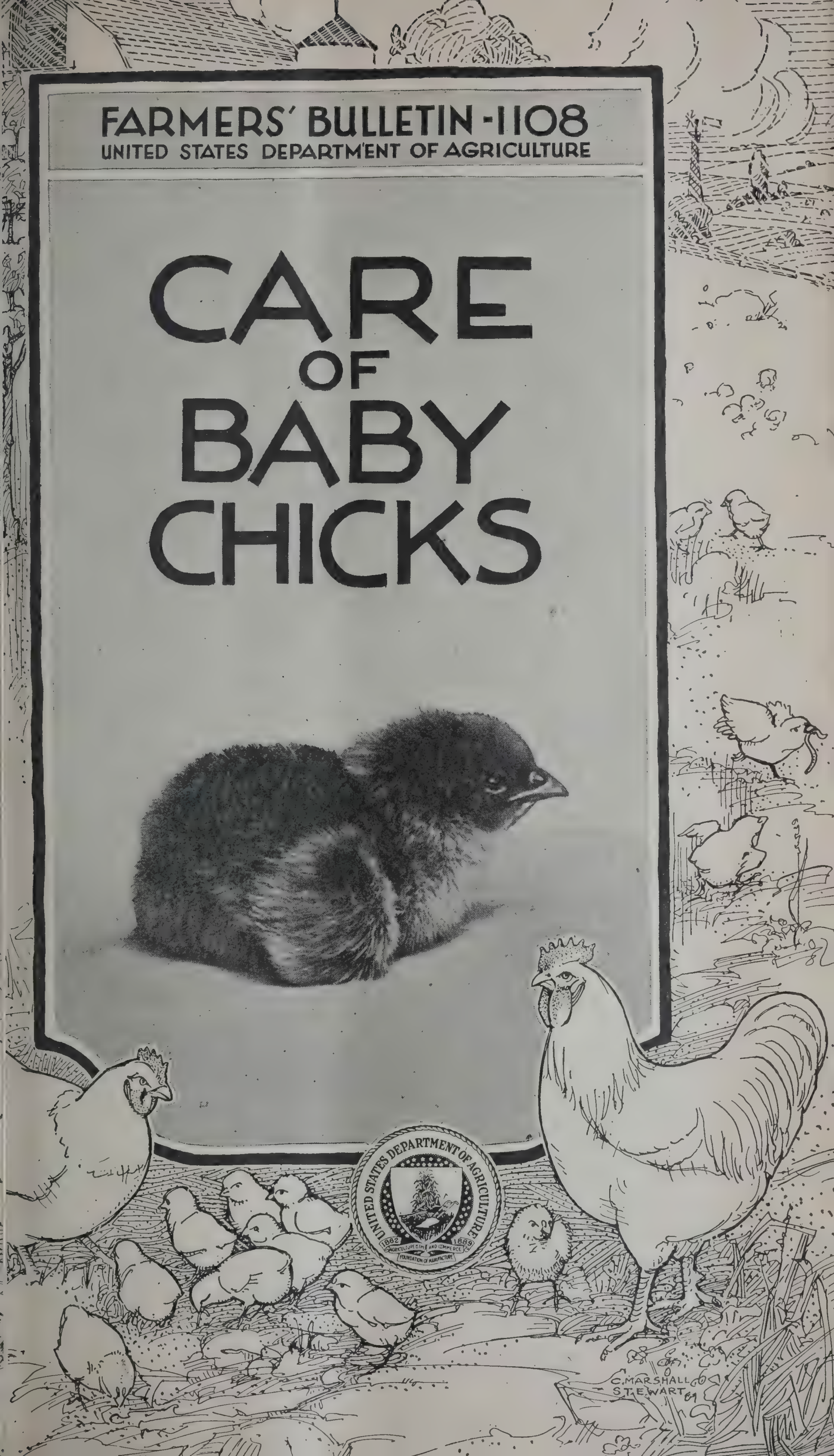
UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1

FARMERS' BULLETIN-1108

UNITED STATES DEPARTMENT OF AGRICULTURE

CARE OF BABY CHICKS



THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs. For additional and more complete information on this subject ask for Farmers' Bulletin 624, "Natural and Artificial Brooding of Chickens."

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. Issued August, 1920

CARE OF BABY CHICKS.

ALFRED R. LEE,
Poultryman, Animal Husbandry Division.

CONTENTS.

Page.
e at hatching time.. 3
ep the chicks warm.. 4
ergency brooder.. 5
eding baby chicks.. 6

HE care of the baby chicks is most important. They must be
kept warm and comfortable, have proper feed and water, and
cared for frequently and regularly, if they are to get the start
life that will enable them to develop into large, hardy chicks and
ature fowls.

CARE AT HATCHING TIME.

Most boys and girls set eggs and hatch their chicks under hens,
hich is the best way unless a very large number of chicks is to be
ised, in which case an incubator may be used. When the mother
n is hatching she should not be disturbed except to remove the
ells, unless she becomes uneasy and steps on or picks the chickens.
such cases the chickens should be removed as soon as dry. Place
em in a basket or box lined with flannel or some other soft mate-
al and cover the top, keeping the basket or box in a warm place
ntil the eggs left under the hen are hatched.

Hens should be fed as soon as possible after the eggs are hatched,
feeding tends to keep them quiet; otherwise many hens will
ave the nest. In most cases it is best that the hen remain on the
est and brood the chickens for at least 24 hours after the hatching
over. Hens will successfully brood 10 to 15 chickens early in
e breeding season, and 18 to 25 in warm weather, depending upon
e size of the hen, so that often two broods of chicks which hatch
t the same time can be put together and raised under one hen.

Powder the hen with a good insect powder or with sodium fluorid
wo days before the chicks are due to hatch. If lice appear on the
hickens, or if they are troubled with "head lice," a very little
rease, such as lard or vaseline, may be applied with the fingers on
he head, neck, under the wings, and around the vent. Great care

should be taken, however, not to get too much grease on the chickens, as it will stop their growth and in some cases may prove fatal

"Toe punch" or mark each chick before transferring to the brood coop, so that the age can be readily determined after maturity.

KEEP THE CHICKS WARM.

Every poultry-club member should always bear in mind that newly hatched chicks are delicate little fellows and must be treated with care. They hatch in a temperature of 102° to 105° F., and their first and most important requirement for the next 48 hours or more is warmth. As soon as the chicks have been taken from the nest or incubator and placed in the brood coop with the mother hen, or in the brooder, they must be kept warm and comfortable until they are old and strong enough to run about and withstand the changes of weather.

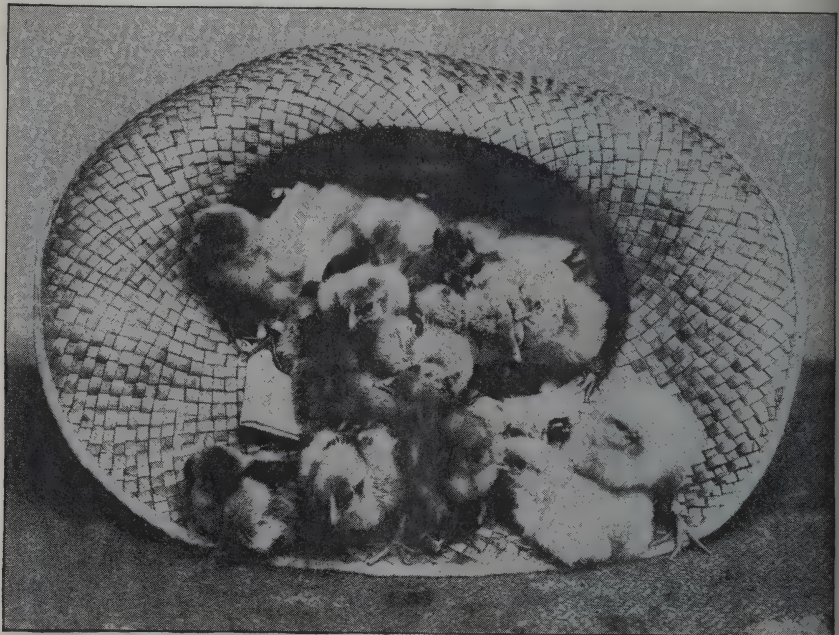


FIG. 1.—A "hatful" of baby chicks just taken from the nest. They were less than 24 hours old when the picture was taken, and only a few were thoroughly awake.

When brooded by hens the chicks remain under the mother of their own accord nearly all the time for the first two or three days. The hen should be confined to the brood coop until the chicks are weaned, while the chickens should be allowed free range if possible after they are a few days old.

If they are to be reared in a brooder, the brooder should be warmed to the proper temperature (about 95° F.), regulated and made dy in advance. Never wait to heat up the brooder until after chicks have been put in. This same rule applies if you purchase -old chicks instead of hatching them. Always have the brooder

. 2.—A newly hatched family of baby chicks about to be put into the brood coop with the mother hen and receive their first feed.

ady so that when the chicks reach you they can be transferred at ice from the shipping box in which they arrive to the brooder, here it is warm, roomy, and comfortable.

EMERGENCY BROODER.

If the mother hen should die, or if the brooder ordered fails to rive in time, boys and girls are sometimes at a loss to know what do with the chicks. In such case a temporary or homemade rooder may be made as follows: Take a box, without cover, about 8 to 24 inches square and 10 inches high. In one side next the bottom cut an opening 3 inches high and 8 or 10 inches long for the chicks to pass through. Protect this opening with a strip of woolen cloth; tack at the upper edge, having perpendicular slits cut from the lower edge to within one-half inch of the top to allow the chicks to pass through. This box, covered over the top with a heavy blanket or any warm cloth, may be used without heat when the temperature of the room in which the brooder is located is 70° F. or over. If the temperature is lower, however, or if the chicks appear to be cold, take a large bottle or jug and fill it with hot water and place it inside the box, refilling the bottle as often as necessary to keep the chicks warm and comfortable.

FEEDING BABY CHICKS.

Baby chicks should not be fed until 24 to 36 hours after hatching, and will not suffer if not fed until they are 48 hours old. The yolk of the egg which is absorbed by the chick just before hatching furnishes all the nourishment required for the first 2 days. After the second day they should be fed four or five times each day for a week or 10 days, but only a small amount at a time. Chicks will grow faster if fed four or five times each day than if fed only three times, but they should receive only what they will eat up clean each time. Overfeeding will do more harm than underfeeding; therefore care should be taken that only a sufficient amount be given each time to satisfy their hunger and keep them exercising. It is very important that the chickens be fed regularly.

The first feed should consist of baked johnnycake broken up into small pieces, or hard-boiled eggs mixed with stale-bread crumbs or dry oatmeal, using a sufficient amount of the cereal to make a dry, crumbly mixture. These feeds or combinations of feeds may be used with good results for a week; then gradually substitute for one or two feeds each day a mixture of equal parts of finely cracked wheat, cracked corn, and pinhead oatmeal or hulled oats, to which may be added a small quantity of broken rice, millet, rapeseed, or charcoal if obtainable. This mixture makes an ideal ration. If corn can not be had, cracked kafir or rolled or hulled barley may be substituted. A commercial chick feed containing a variety of grains can be bought from most feed dealers and may be used instead of the home mixture if desired.

How to make johnnycake for chicks.

Corn meal	5 pounds.
Infertile eggs (tested out from sittings or from an incubator)	6.
Baking soda	1 tablespoon.

Mix with milk to make a stiff batter, and bake thoroughly.

NOTE.—When infertile eggs are not available use a double quantity of baking soda and add one-third pound of sifted beef scrap.

When the chicks are from 10 days to 2 weeks old use a mash, composed of the following, to take the place of the johnnycake or bread. All ingredients are measured by weight.

2 parts bran.
2 parts middlings or oatmeal.
1 part corn meal.
½ part or 10 per cent sifted meat scrap.

This mash may be placed in a hopper, where it can not be wasted, and left before the chicks at all times, or it may be fed as a moist, crumbly mash once each day, and the grains fed the chicks three times a day. When the chickens are 8 or 10 weeks old add 1 part of ground oats, increase the meat scrap to 1 part, the corn meal to 2 parts, and decrease the bran to 1 part.

As soon as the chickens are old enough and will eat whole wheat, cracked corn, or other grains, the small-sized feed may be discontinued and the larger-sized grains fed to the chickens three times a day. In addition to the grain feed, chickens must be supplied with grit, oyster shell, and charcoal at all times, and the better way is to place these in a hopper, hanging it in a convenient place so that the chicks may help themselves. Use sifted or chick-size grit and oyster shell until the chicks are 8 to 10 weeks old.

If chicks are kept in confinement they must be furnished a liberal supply of tender, green feed, like lawn clippings, sprouted oats, cabbage or lettuce leaves, and such other things as may be available. If the chicks have to be kept confined to a small coop with a yard attached, move the coop and yard to fresh grass or soil every few days or before the grass is killed. Whenever possible, however, chicks should have grass range, when they will obtain their own green feed, and catch bugs and worms. Chicks that are allowed to run on a grass range are usually strong and thrifty and will grow much more rapidly than those that are kept in confinement.

The chickens' growth may be hastened considerably by giving them sour milk to drink in addition to other feeds. Chickens are very fond of milk in any form and will consume a liberal supply of it. Either sweet or sour milk may be fed, but the latter is more desirable. Sour milk will help to keep chickens healthy and is one of the best things that can be fed to promote rapid growth and development. When plenty of milk is fed, the amount of meat scrap in the mash may be reduced one-half or entirely omitted.

FARMERS' BULLETINS ESPECIALLY USEFUL FOR MEMBERS OF BOY AND GIRLS' POULTRY CLUBS.

1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1109. Preserving Eggs.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.
1116. The Selection and Care of Poultry Breeding Stock.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.
585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
656. The Community Egg Circle.
682. A Simple Trap Nest for Poultry.
684. Squab Raising.
697. Duck Raising.
767. Goose Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. The American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-Yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continenta Classes.
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and Frenc Classes.
1067. Feeding Hens for Egg Production.

For copies of these bulletins or further information on poultry raising, write t your poultry-club leader, or to the Animal Husbandry Division, Bureau of Anima Industry,

UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

○

FARMERS' BULLETIN 1109

UNITED STATES DEPARTMENT OF AGRICULTURE

PRESERVING EGGS

THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. Issued September, 1920; reprint June, 1921

PRESERVING EGGS

Jos. Wm. Kinghorne,
Animal Husbandry Division.

CONTENTS.

	Page.		Page.
Preserving eggs for home use	3	Using preserved eggs	4
Preserving in water glass	3	An infertile egg	5
Preserving with lime solution	4	A fertile egg	5
Best results	4	Candling eggs	6

PRESERVING EGGS FOR HOME USE.

EVERY boy and girl who is a member of a poultry club or who is in any way interested in poultry keeping should learn how to candle and preserve eggs. During the late spring and early summer (April, May, and June) eggs usually are abundant and reasonable in price, and that is the time to preserve them for use during the winter, when they are generally scarce and the prices are high. Fresh eggs, properly preserved, may be kept from 6 to 10 months and be almost as good for all household purposes as fresh eggs.

PRESERVING IN WATER GLASS.

To preserve 15 dozen eggs in water glass, the following directions should be followed:

(1) Select a 5-gallon crock (earthen or stone) and clean it thoroughly, then scald and allow to dry.

(2) Heat 10 to 12 quarts of water to the boiling point and allow it to cool.

(3) When cool, measure out 9 quarts of water, place in the crock, and add 1 quart of sodium silicate (commonly called water glass), which can be purchased at almost any drug store. Stir well so that the solution becomes thoroughly mixed.

The solution thus prepared is ready for the eggs, which may be put in all at once or from time to time as they are obtainable. Care should be taken in putting them in the jar not to crack or break the shells; also make sure that the solution covers the eggs by at least two inches at all times.

Put the crock containing the preserved eggs in a cool, dry place and cover with a tight lid or waxed paper to prevent evaporation.

To preserve a smaller or larger number of eggs, the solution should be mixed and prepared in the same proportion.

PRESERVING WITH LIME SOLUTION.

If water glass is not obtainable, lime may be used. It is not considered so good as water glass, as in some instances eggs preserved by this method have tasted slightly of lime, although at other times limewater has proved entirely satisfactory.

To preserve with lime, dissolve 2 pounds of unslaked lime in a small quantity of water and dilute with 5 gallons of water that has previously been boiled and cooled. Allow the mixture to stand until the lime settles, then pour off and use the clear liquid. Place clean, fresh eggs in a clean earthenware crock or jar and pour the clear limewater into the vessel until the eggs are covered. At least 2 inches of the solution should cover the top layer of eggs.

BEST RESULTS.

If best results are to be obtained the eggs should be fresh and clean and preferably infertile. For this reason it is always best when possible to candle the eggs carefully before preserving them unless they are known to be strictly fresh. If an egg is only slightly soiled a cloth dampened with vinegar may be used to remove the stains, but eggs should not be washed with water or soap and water, as water removes the protective coating that is on the shell and may tend to cause the contents to spoil. Under no circumstances should badly soiled or cracked eggs be used for preserving, as one or more such eggs in a jar may spoil all the others.

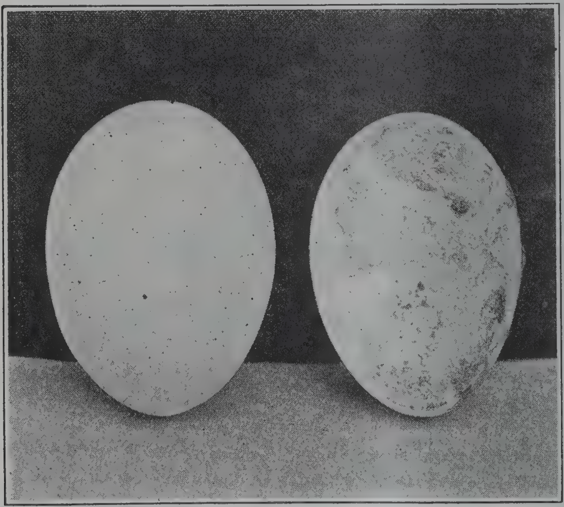


FIG. 1.—Only clean eggs, such as the one on the left, should be preserved. The egg on the right is too much soiled to preserve.

USING PRESERVED EGGS.

Fresh eggs preserved according to these directions will usually keep from 6 to 10 months and can be used satisfactorily for all purposes in cooking and for the table. If, however, preserved eggs are to be boiled, a small hole should be made with a pin in the larger end of the shell before placing them in the water, to allow the air in the egg to escape when heated and thus prevent cracking.

AN INFERTILE EGG.

An infertile egg is one laid by a hen that has not been with a male ird for 2 or 3 weeks and the germ cell of which is not fertilized. The ength of time varies somewhat, but ordinarily all eggs will be in-ertile after the male has been separated from the flock for from 2 to 3 veeks. If the germ cell of the egg has not been fertilized the egg will ot hatch, and it is impossible for a blood ring to form in such an egg vhen exposed to heat, which so often happens with fertile eggs. In-ertile eggs will keep much longer than fertile ones, and are best for ll purposes except hatching.

A FERTILE EGG.

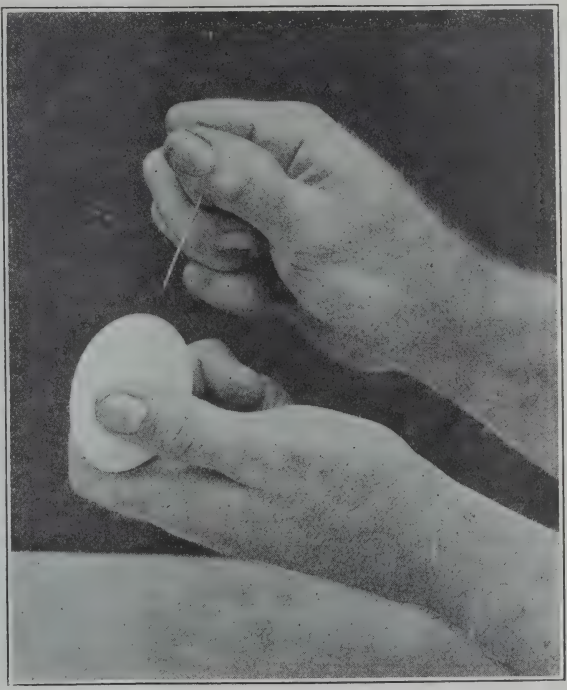


FIG. 2.—Punching a hole in the shell of a preserved egg before boiling.

A fertile egg is just the opposite of an infertile one. It is an egg aid by a hen that as been allowed to un with a male bird vithin 2 or 3 weeks nd the germ cell of vhich is fertilized. he length of time equired for fertiliza-ion varies some-vhat, depending pon the vigor of he male. Generally peaking, however, a ood percentage of he eggs will prove ertile after the male as been with the lock from 2 to 3 veeks. Fertile eggs re the ones from vhich chicks are atched, and are de-irable for hatching urposes only, as hey spoil much sooner than infertile eggs, often resulting in heavy loss.

Every boy or girl is urged to read carefully and study the chart of ertile and infertile eggs shown on the back page of this bulletin. Remember the information given. The male bird makes the egg ertile, and the fertile egg, if heated, develops a blood ring, making t unfit to eat. If you do not wish to hatch the eggs, do not keep a nale bird. If you do want hatching eggs, then allow the male to un with the flock during the hatching season, but take him away after the hatching is completed. The hens will lay just as many egg without a male as with one.

CANDLING EGGS.

By the term "candling" is meant the discarding or sorting out the bad eggs from the good ones by holding the egg before a stron light in such manner that the rays of the light come to the ey through the egg so that the condition of the contents can be seen.

The shell of a new-laid egg has a soft "glow" or "bloom" which a visible sign of perfect freshness. This glow or bloom is destroye by handling and in any case disappears after the egg has been expose to the air for a short time. After that it is difficult to tell a fresh eg from an old one by the appearance of the shell; therefore candlin becomes necessary if you would be sure that the egg is good.

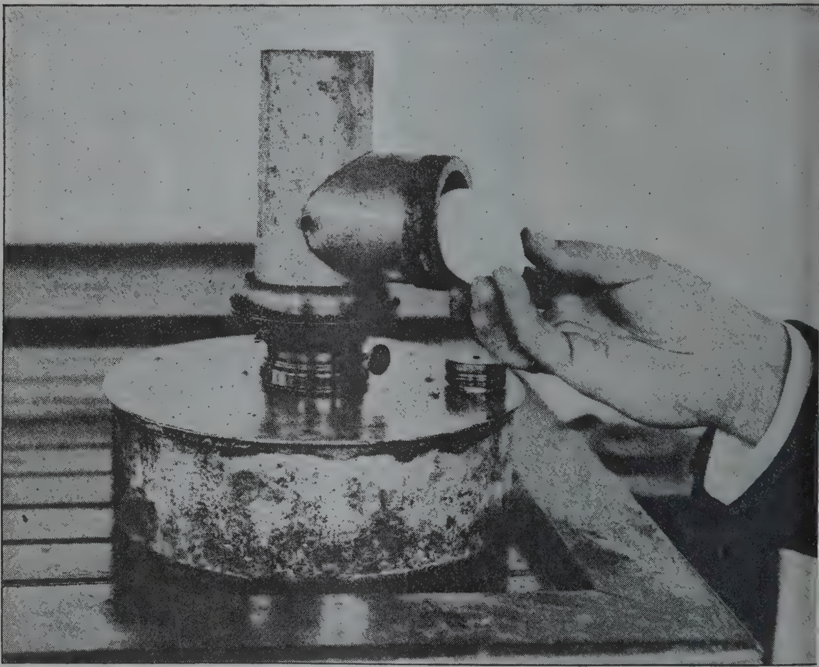


FIG. 3.—Testing an egg by the use of a metal-chimney tester which usually comes with an incubator which can be purchased from poultry-supply houses. Such a tester can be readily fitted on incubator lamp.

Eggs can be candled best in a dark room, by the use of a bright lig inclosed in a box or case having a hole a trifle smaller than an eg directly opposite the light. At this hole the egg is held for examin tion. An ordinary hand lamp, a lantern, an incandescent bulb, or flashlight may be used. Any box that, set on end, is large enoug to hold the lamp will do. In addition to the hole opposite the lig ıere should be a hole at the top end of the box; otherwise the heat ·om the top of the chimney would set the box on fire. A tester ıimney made of tin such as is used on a lamp for testing eggs in ıcubators may be used for candling. When such a chimney is vailable the box is not necessary, as the eggs are tested by means of ıe hole in the side of the chimney. (See fig. 3.)

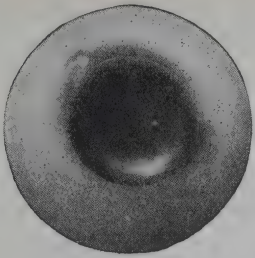
The box and light should be placed on a table or a shelf where most onvenient. Place on one side the eggs that are to be candled and n the other side have separate boxes (or anything that will hold the ggs) for the good and the bad eggs. Hold the eggs, one by one, large ıd up, close to the light.

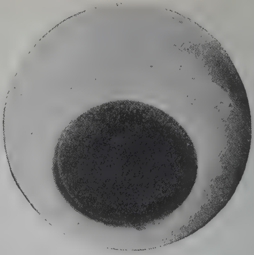
A perfectly good fresh egg shows "full" and "clear" before the ght. There is almost no air cell at the large end, and the yolk ıtline is only faintly visible. A fixed air cell of one-eighth to threextteenths of an inch in depth indicates a fresh egg as eggs run enerally. A larger air cell with a movable lower line indicates—cording to sizes and fluctuations—a stale egg or one becoming eak and watery.

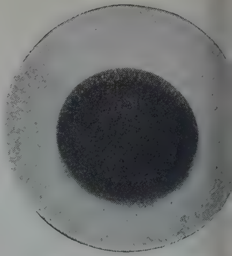
Very small dark spots which sometimes may be seen are usually lood clots. Large dark spots, blood rings, and shadows are due to eat and germination and indicate the first stages of decay. An egg ıat looks very dark or black, except for a large fixed air cell, contains chick at an advanced stage of incubation. An egg which looks ark when tested in the same way but shows a large air cell with a ovable lower line is usually in an advanced stage of fluid decompotion, or what is commonly known as a "rotten egg."

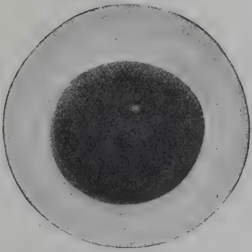
At first it may be a little difficult for some boys and girls to test ıe eggs as here directed, but with a little practice it becomes a very mple matter.

PRODUCE INFERTILE EGGS.


1. Fresh egg.

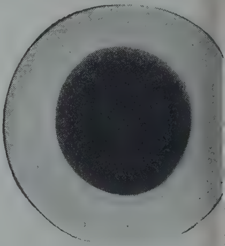

2. Infertile egg after 24 hours at 103° F. No blood ring. Good for food; would be still better if kept cool.


3. Infertile egg after 48 hours 103° F. Still good food.

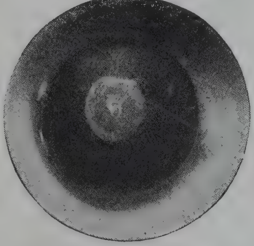

4. Infertile egg after 72 hours at 103° F. Not absolutely fresh, but useful in cookery.

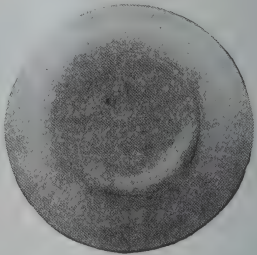
After the hatching season, cook, sell, or pen your rooster. Hens not running with a male bird will produce infertile eggs—quality eggs that keep best and market best.

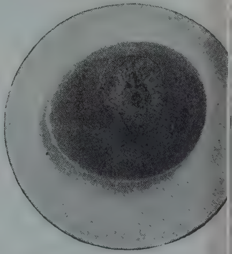
The rooster does not help the hens to lay.

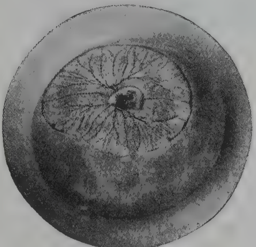

5. Infertile egg after 7 day
103° F. Still usable for fo
It would be a perfect egg
had been kept cool.

Infertile eggs keep better than fertile eggs in summer.

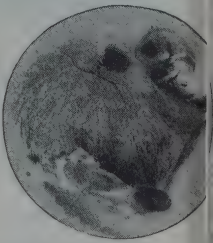

1. Fertile egg after 24 hours at 103° F. Fertile germ beginning to hatch. Not perfect for food.


2. Fertile egg after 36 hours at 103° F. Blood ring formed. Not good for food.


3. Fertile egg after 48 hour
103° F. Blood ring f
developed. Unfit for mar


4. Fertile egg after 72 hours at 103° F. Blood vessels of embryo chick clearly marked.

Fertile eggs cost farmers $15,000,000 a year. This loss is preventable. The rooster makes the egg fertile. The fertile egg makes the blood ring, which spoils the egg for food and market.


5. Fertile egg after 7 day
103° F. Compare with
fertile egg.

Fertile eggs spoil quickly in summer weather.

WASHINGTON : GOVERNMENT PRINTING O

FARMERS' BULLETIN - 1110
UNITED STATES DEPARTMENT OF AGRICULTURE

LICE, MITES AND CLEANLINESS

THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs. For additional and more complete information on the subject the reader should ask for Farmers' Bulletin 801, "Mites and Lice on Poultry." This may be obtained in many cases from club leaders or will be supplied free of charge on application to the U. S. Department of Agriculture, Washington, D. C.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C.
Issued September, 1920; reprint, August, 1921

LICE, MITES, AND CLEANLINESS.

J. W. Kinghorne and D. M. Green,
Animal Husbandry Division.[1]

CONTENTS.

	Page.
Kinds of lice	3
Body lice	4
Feather lice	
How to get rid of body and feather lice	4
Head lice	5
Poultry mites	6
"Stick-tight" fleas	7
Poultry ticks, or "blue bugs"	8
Dust bath	8
Whitewash	9
Cleanliness	9
Chiggers, or "red bugs"	9

LICE and mites are common pests that usually can be found wherever poultry is kept. They are a source of continuous annoyance, and if present in large numbers cause slow or stunted growth as well as death in young chicks, and reduce flesh and egg production in mature birds. For this reason every boy and girl must keep the fowls as well as the poultry houses, nests, brood coops, etc., free from lice, mites, and other vermin, if he or she is to succeed with poultry or poultry-club work.

KINDS OF LICE.

More than 40 distinct species of lice infest the different varieties of domestic poultry. Seven species are commonly found on hens and chickens, 4 or 5 on pigeons, 2 or 3 each on ducks and geese, 3 on turkeys, and several each on guinea fowl and peafowl. The kinds most common on hens and chickens, however, are usually classed in three groups, known as body lice, head lice, and feather lice. They intermingle to a considerable extent, and their habits are very similar, but all are a pest and an annoyance to the fowls and should be destroyed.

---

[1] Much of the information given in this bulletin is drawn from Farmers' Bulletin 801, "Mites and Lice on Poultry," by F. C. Bishopp and H. P. Wood, of the Bureau of Entomology.

These different species of lice never leave the bodies or feathers of the fowls. They differ somewhat in size and appearance, but all are fitted with peculiarly arranged legs which permit them to move about rapidly through the feathers. They have sharp, strong, biting mouths, but unlike the red and gray mites are not fitted for sucking blood; instead, they feed on portions of the feathers and on scales from the skin.

BODY LICE.

The body louse is much larger than the red or gray mite, and is straw or pale yellow in color. It lives and breeds entirely on the body of the fowl, centering its activities on those sections that are not closely feathered, although it may sometimes be found on the head, neck, or other parts of the body. It is usually found in greatest numbers under the wings and around the vent, and oftentimes the skin of the fowl where the lice are thickest will appear red and rough, and quite often scabs and blood clots may be seen. These are evidence of long irritation, preventing normal growth and development in chicks, and causing sickness and loss of vigor in mature fowls.

Body lice deposit their eggs in clusters on the web part of the feather close to the quill. On mature fowls they are to be found in greatest numbers on the small, short feathers below the vent. On chicks the eggs are often deposited on the soft, downy feathers about the head and throat. The eggs hatch in about a week, and the lice reach their full size in about 20 days; therefore, if the lice are no killed, the fowls become alive with them in a very short time.

FEATHER LICE.

Feather lice are the species most commonly found on poultry, bu are probably the least important, for the reason that they stay on the feathers the greater part of the time and feed on the feathers and scales along the quill rather than on the skin or body of the fowl They are smaller than the body lice but otherwise resemble them somewhat in appearance. They can be detected easily, however, upon parting the feathers on the back or breast, where usually they can be found clinging to the web and shaft of the feather. Feather lic infest mature fowls and are seldom found on young chicks.

HOW TO GET RID OF BODY AND FEATHER LICE.

Inasmuch as poultry lice stay on the fowls nearly all the time, th only effective treatments are those which are applied directly to th birds.

Sodium fluorid, a powder which can be purchased at most dru stores, is the most effective remedy, being exceedingly poisonous to al inds of poultry lice. It should be applied by placing a small amount f the powder (as much as can be held between the thumb and finger) mong the feathers next to the skin on the head, neck, back, under he wings, on the breast, below the vent, and at the base of the tail.

Not more than 12 small pinches should be put on one fowl at a ime, as too much is injurious. One pound of powdered sodium luorid applied in this manner will treat 100 fowls and is very ffective. It is usually advisable to treat fowls in the spring just efore the brooding season, which will help to keep the young chicks ree from vermin. Sodium fluorid if inhaled is very irritating to ither fowls or human beings. If too much is inhaled by fowls or hicks it will be fatal. Therefore, precaution should be taken in reating fowls to see that it is not inhaled or allowed to get into any uts or wounds in the flesh.

Blue ointment is another effective remedy. In using it apply a mall portion (a piece about the size of a pea) with the fingers round the vent only of the fowl, and not on the body or under the vings. Care should be taken not to get any of the ointment into the ent, as it is poisonous and injurious. If mercurial ointment (a imilar preparation) is used instead of blue ointment, it should be liluted with one-half the quantity of vaseline or lard.

Lice powders of various kinds are also on the market (they can isually be purchased at stores and poultry-supply houses) and may e used oftentimes with good results. These lice powders should e dusted well into the feathers (see illustration on front cover), vorking the powder in with the fingers, especially under the wings nd around the vent, to make sure it reaches the skin. If all the lice re not killed by the first treatment the fowls should be dusted gain in a week or ten days and as often afterwards as found necesary.

HEAD LICE.

Head lice, so called because of their habits, are found on the heads f both chicks and mature fowls, but most often on young chicks. hey are longer and more slender than body lice, and dark brown in olor. They are almost always in greatest number on the top of he head, around the ears, and underneath the bill, and are usually ound with their heads close against the skin of the chicks, the body xtending outward. Head lice are very injurious. They breed apidly and pass from the mother hen to young chicks and from one hick to another, which makes it necessary to watch the flock careully in order to keep the chickens free from these pests.

To kill head lice on chicks, a very small portion of melted lard or aseline should be applied to the top of the head, under the wings, and around the vent. Care should be taken not to get too much grease on the chick, as that might prove fatal. These head lice are very injurious and chicks should be examined often for them and be treated at once whenever the lice are found.

POULTRY MITES.

Of all parasites affecting poultry it is probable that ordinary poultry mites are the most troublesome and destructive unless kept under control. Unlike the lice, poultry mites are bloodsucking parasites and live entirely on the blood of the fowl. They are very small and are gray in color. However, after they have been on the body of the fowl and filled themselves with blood they look red and are called red mites. When they are not filled with blood they look gray and are called gray mites. They do not stay on the fowl's body all the time, like lice, but during the day hide away in cracks and crevices, behind boards that are near the roosts, in the cracks of brood coops, and in other places. At night when the fowls and chicks go to roost the mites come out of their hiding places, crawl on to the birds, and suck the blood from their bodies. The irritation and loss of blood cause mature fowls to become pale in comb and wattles and poor in flesh; sitting hens may desert their nests and spoil their eggs, if they do not die on the nests, and chickens become weak and droopy and in many instances die from the attacks.

These mites are very small and sometimes hide themselves away so completely that the boy or girl may think the houses, coops, etc., are free from them unless a careful search is made. Knowing their hiding places, however, every club member should look for them very carefully every ten days or two weeks, especially during the summer, when they breed most rapidly, and if any signs of their presence are found, begin at once to get rid of them.

Since poultry mites hide away in cracks and crevices during the day, the first thing that should be done to get rid of them is to give the poultry houses, roosts, nests, etc., a good cleaning. After the cleaning, spray thoroughly with kerosene, crude oil, or some heavy coal-tar preparation, making sure that the spray reaches all the cracks and crevices and every other place where the mites may be hiding. The heavy coal-tar preparations are most effective and last longest. They can be purchased at most drug stores, with full directions for mixing and use. It is necessary to spray thoroughly and often, especially during warm weather, if the mites are to be kept from annoying the fowls.

"STICK-TIGHT" FLEAS.

In many of the Southern and Southwestern States fowls and chicks re often infested by a species of flea commonly known as the "stick-ight" flea, taking the name from its habit of sticking to one place n the bird instead of moving about like lice and mites. They are sually found in clusters on the comb and wattles and around the eyes. hicks when infested often die quickly. Old fowls, while usually tronger and more resistant, will cease laying, or nearly so, and someimes die as a result of the attacks of these fleas.

"Stick-tight" fleas breed in cracks and crevices of the floors of rood coops and poultry houses, also in dry animal or vegetable refuse, ut will not breed in damp or wet places. Therefore to get rid of them t is necessary to clean and spray the houses and runs thoroughly as vell as to treat the birds. Grease the comb and wattles of the fowls nd chicks with a preparation of kerosene and lard (1 part kerosene to parts of lard), being very careful not to use too much of the mixture r get any of it in the birds' eyes or on other places where it is not ecessary, as it may cause injury if used too freely. Clean and spray he coops and houses thoroughly the same as for poultry mites; also vet or spray the yards or runs, especially any dry soil about the poulry houses, such as dirt floors or ground underneath a board floor, vith a solution of salt and water, which helps to keep the ground oist and prevents the fleas from breeding.

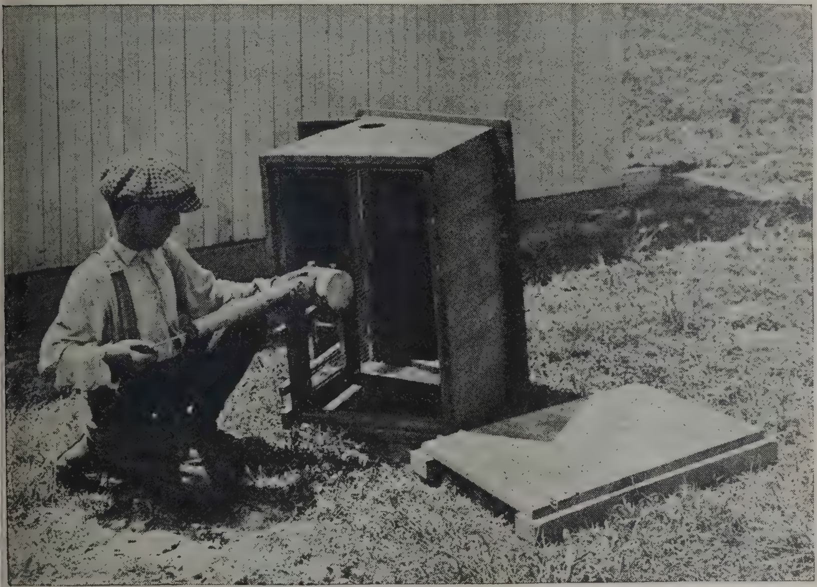


FIG. 1.—Boy club member spraying his brood coop to kill the poultry mites.

POULTRY TICKS, OR "BLUE BUGS."

Poultry ticks, or "blue bugs," are common in the Southern States and are very injurious to poultry and pigeons. Their habits are very similar to those of the little red and gray mites in that the adult bugs crawl on the bodies of the birds and feed at night only and during the day hide in cracks and crevices about the poultry house. The young ticks hatch and remain on the bodies of the fowls for from 3 to 10 days, when they leave. After that, they attack the chicks and fowls only when they have gone to roost at night. These "blue bugs" are about the size of a bedbug and much more harmful than either lice or mites.

Ticks, or "blue bugs," are much harder to kill than either lice or mites, ordinary lice powders or insecticides having little effect upon them. If the poultry house or coops become infested, remove the birds to temporary quarters for a period of 10 days, during which time the young ticks on the birds become filled with blood and fall off, when the birds should be at once removed. In the meantime thoroughly clean the poultry house by removing all nest boxes and nesting material, roosts, and other loose objects, and spray liberally with crude petroleum or kerosene or wood preservative. In spraying, make sure that the spray reaches all places where the bugs may be in hiding. Brood coops or temporary quarters, such as crates, etc., that may be infested, may be disinfected by scalding thoroughly with boiling water. For additional information the reader is referred to Farmers' Bulletin 1070, "The Fowl Tick," which treats of this pest more fully.

CHIGGERS, OR "RED BUGS."

Chiggers, "red bugs," or harvest mites are also quite troublesome in the Southern and Central States. They breed in the tall grass and are usually most plentiful in low-lying land. They attack fowls and chicks that are on range, attaching to the skin, causing an intense itching. Abscesses a third of an inch in diameter, surrounded by an area of inflammation, often may be found where clusters of these "red bugs" are feeding, and as a result the birds refuse to eat, become weak and droopy and soon die from hunger and exhaustion.

Fowls or chicks that have been attacked by chiggers, or "red bugs," if discovered before abscesses are formed on the skin, should have the inflamed parts treated with sulphur ointment, or a mixture of 1 part kerosene with 3 parts melted lard. If pus has already formed in the sore, remove the scab and wash the sore with a 4 per cent solution of carbolic acid and water. In sections where "red bugs" are plentiful, if fowls and chicks have free range, the grass hould be kept short to prevent the bugs from breeding; also dust he birds occasionally with flowers of sulphur, rubbing it well into he feathers. Club members should also hatch their chickens as arly in the season as possible, so that when the hot weather comes n, when these bugs are most troublesome, the chicks will be old nough to resist their attacks.

DUST BATH.

It is always advisable to provide a good dust bath in which the owls and chickens can dust themselves whenever they wish, as in loing so they help to keep the lice under control and in some intances almost free themselves from them.

WHITEWASH.

Whitewash is also effective in killing mites and other vermin and nay be used freely in spraying the houses, brood coops, roosts, etc. n badly infested places it is advisable to clean and spray, as lready described, and in about 48 hours follow with a good spray or oating of whitewash. An effective whitewash for this purpose is nade as follows:

Slake half a peck of lime and dilute it with 20 gallons of water; add pound of salt previously dissolved in water; to this mixture add 2 quarts of crude carbolic acid. Apply with a spray pump or brush. This mixture if properly put on not only kills the mites but destroys ll eggs, and will make the house, or any building where it is used, resh and clean.

CLEANLINESS.

Cleanliness is of the greatest importance in keeping lice and mites, fleas, and other insects under control, and should have the closest attention of every boy and girl. The poultry houses, roosts, dropping boards, brood coops, and all other places that the fowls or chickens occupy should be kept clean. An abundance of light and fresh air should also be provided. While these things can not be depended on to keep away lice and mites, they make it easier to determine when the pests are present and help to keep the fowls healthy and vigorous, making them better able to withstand and to fight off the attacks of lice and mites. Sick or diseased fowls are always the first victims of these parasites, which makes it important that the fowls be kept healthy.

FARMERS' BULLETINS SPECIALLY USEFUL FOR MEMBERS OF BOYS' AND GIRLS' POULTRY CLUBS.

1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.
1116. Selection and Care of Poultry Breeding Stock.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.
585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
682. A Simple Trap Nest for Poultry.
656. The Community Egg Circle.
684. Squab Raising.
697. Duck Raising.
767. Goose Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. The American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-Yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continental Classes.
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and French Classes.
1067. Feeding Hens for Egg Production.

Bureau of Chemistry Circular 61, revised, How to Kill and Bleed Market Poultry.

For copies of these bulletins or further information on poultry raising, write to your poultry-club leader, or to the Animal Husbandry Division, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C.

HOW TO DO IT

DO YOU WANT practical suggestions on how to build a silo, a hog house, a poultry house, a potato storage house, or how to make a fireless cooker, or other farm home convenience, a flytrap, or a self-feeder for hogs? Are you seeking ideas on how to prepare vegetables for the table, how to care for food in the home, how to bake bread and cake and other appetizing foods in an efficient and economical manner? Is there some practical question about your corn or wheat or cotton or other crops, or about your poultry or live stock, to which you are seeking an answer? The answers to thousands of such questions and practical suggestions for doing thousands of things about the farm and home are contained in over 500 Farmers' Bulletins, which can be obtained upon application to the Division of Publications, United States Department of Agriculture, Washington, D. C.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1921

FARMERS' BULLETIN · 1111
UNITED STATES DEPARTMENT OF AGRICULTURE

MANAGEMENT OF GROWING CHICKS

THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. —, 1920

MANAGEMENT OF GROWING CHICKS.

J. W. KINGHORNE,
Animal Husbandry Division.

CONTENTS.

	Page.
Essentials to proper growth	3
Coops and houses	3
Cleanliness	4
Feeds and water	4
Range and shade	6
Keep standardbred poultry	7

THE care of growing chicks, especially during very warm weather, is most important, and every boy or girl who is a member of a poultry club or is raising chickens should give them the best of care at this time if he or she wishes to succeed. The baby chicks may be smart little fellows from strong, vigorous parent stock, and they may have been brooded carefully for the first two or three weeks, but unless they receive proper care and management during their later growing period they will not develop properly, and many of them will be lost by sickness or disease.

ESSENTIALS TO PROPER GROWTH.

The chief essentials to proper growth are good coops or houses, cleanliness, proper feed and water, shade, and free range.

COOPS AND HOUSES.

Growing chicks should be provided with large, roomy coops or houses which will give them a comfortable place to stay at night and during stormy weather. No particular kind of house is necessary, but it should be so built that it will provide the chicks with lots of light, pure air, and sunshine, and protect them from dampness and storms of all kinds. It also should be arranged so that it can be cleaned easily and frequently, which is very important.

If brood coops are used, do not let too many chicks go into one coop at night, as crowding will cause them to become overheated, resulting in improper growth and sometimes in dead chicks. As the season advances and the chicks become larger, some should be removed and placed in other coops to prevent crowding. When possible it is best to provide larger quarters.

A good house can be built from dry-goods or piano boxes at a small cost. The houses shown in figure 1 were built from two piano boxes and covered with tar paper to keep out the rain, making very satisfactory quarters. In a house of this sort the same care should be taken as in brood coops, that is, not to crowd the chicks.

CLEANLINESS.

Every coop and poultry house used for growing chicks should be kept clean at all times. Sickness or disease usually starts in unclean quarters, and in such quarters lice and mites are always more plentiful. The coops and houses should be cleaned and sprayed once a week, and clean shavings, chaff, or sand put on the floor. Examine the chicks and houses often for lice and mites, and if found they should be got rid of at once by following the directions in Farmers' Bulletin 1110, "Lice, Mites, and Cleanliness."

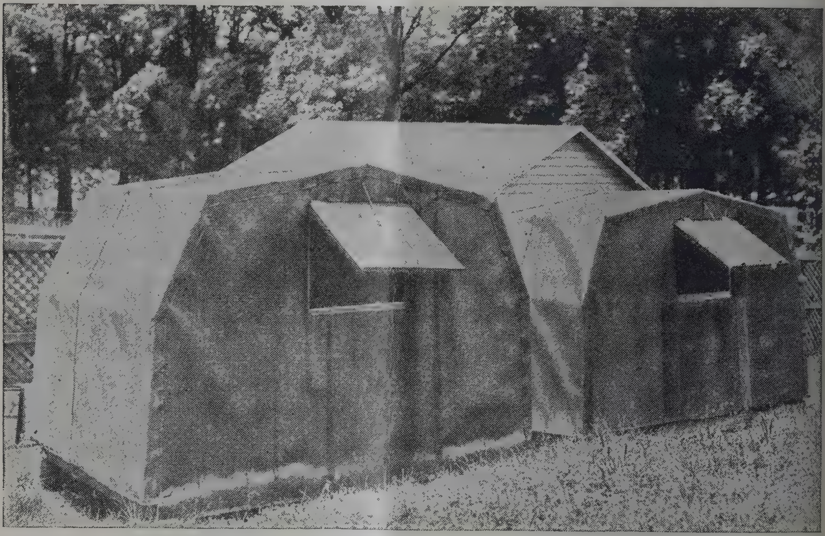


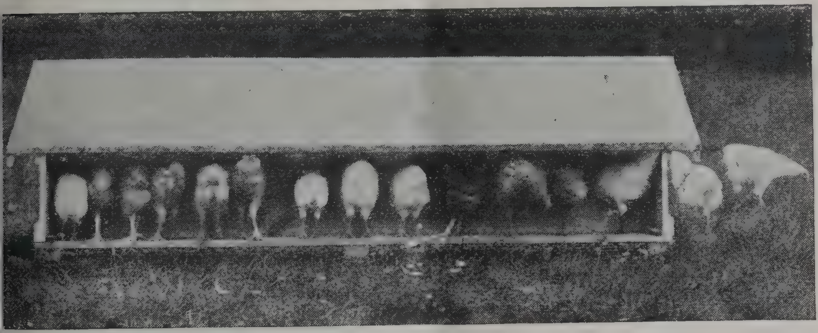
FIG. 1.—Rear view of two houses, each made from two piano boxes, for growing chicks. The entrance door is in front. Note the ventilating window, which is protected by the raised wooden shutter.

FEEDS AND WATER.

A variety of feeds, with fresh, clean water, is necessary if chicks are to grow properly. The three feeds most necessary for rapid growth are grain feed, green feed, and dry mash.

Grain feed.—In addition to the green feed and dry mash, which should be provided regularly, a grain mixture should be fed night d morning, giving as large a quantity as the chicks will eat clean, t no more. A good grain mixture for growing chicks consists of parts cracked corn, 2 parts wheat, and 2 parts hulled oats. When ailable, kafir corn or rolled or hulled barley may be substituted for lled oats. In localities where hulled oats, kafir corn, or rolled bar-y can not be obtained or is too high in price, a mixture of cracked rn and wheat only may be fed until the chicks are old enough to t whole oats, when 2 parts oats may be added to the corn and wheat ixture.

Green feed.—A reasonable supply of fresh green feed is almost as ecessary as grain for growing chicks if they are to develop properly. allowed liberty they will obtain much of it for themselves, but if ept in confinement or in quarters where green feed is not abundant, should be supplied to them regularly. Lawn grass, beet tops, bbage, and lettuce make excellent green feeds.



IG. 2.—A " help-yourself " hopper for feeding dry mash outdoors. The hinged sloping cover permits filling the hopper, protects the contents, and shelters the chicks.

When chicks are confined to brood coops with runs these should be laced on ground where the grass is green and tender, and as fast s it is eaten off the coop and run should be moved to a place where e grass is plentiful.

Dry mash.—In addition to grain and green feeds, dry mash should e kept before growing chicks at all times after they are three or four eeks old. It is best to feed it in a hopper inside the building or here it will not be exposed to rain or wet. If a large number of hicks are raised the mash may be fed in an outdoor hopper (figure 2).

The following mixture makes a good dry mash: Two pounds corn eal, 2 pounds middlings, 1 pound oatmeal, 2 pounds wheat bran, pound beef scrap, and one-fourth pound charcoal. When a larger uantity is desired it should be mixed in the same proportion.

Grit and oyster shell should be provided also, so that the chicks ay help themselves whenever they wish.

Sour milk.—Nothing is better for growing chicks than a liberal upply of sour milk. If it can be obtained, it should be kept always before them in an open dish or pan where they can eat and drink i freely. When sour milk is fed, the amount of beef scrap in the dr mash may be reduced one-half.

Water.—Plenty of fresh, clean water is absolutely necessary for al growing chicks. In hot weather it should be given twice daily and put into fountains or dishes and placed in the shade so as to kee as cool as possible. Clean the water dish thoroughly each day befor filling.

RANGE AND SHADE.

An abundance of free range with plenty of shade is necessary i chicks are to grow rapidly and develop into vigorous fowls. Growing chicks that have free range obtain quantities of green feed, bugs worms, and other things, therefore requiring less grain, and they ar also less liable to sickness or disease. Give your chicks free rang whenever possible.

KEEP STANDARDBRED POULTRY.

Standardbred poultry is more uniform in size, type, and color.

Standardbred poultry is more attractive in appearance and appeals more strongly to purchasers of stock and eggs.

Standardbred poultry offers a greater combination of practical and utility qualities suitable to the needs of the farmer and poultry keeper.

Standardbred products are more uniform in quality, are in greater demand, and bring better prices.

Standardbred poultry means greater success and better profits.

FARMERS' BULLETINS ESPECIALLY USEFUL FOR MEMBERS OF BOYS AND GIRLS' POULTRY CLUBS.

1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1110. Lice, Mites, and Cleanliness.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.
1116. The Selection and Care of Poultry Breeding Stock.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.
585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
656. The Community Egg Circle.
682. A Simple Trap Nest for Poultry.
684. Squab Raising.
697. Duck Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. The American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-Yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continental Classes.
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and French Classes.
1067. Feeding Hens for Egg Production.

For copies of these bulletins or further information on poultry raising, write to your poultry-club leader, or to the Animal Husbandry Division, Bureau of Animal Industry,

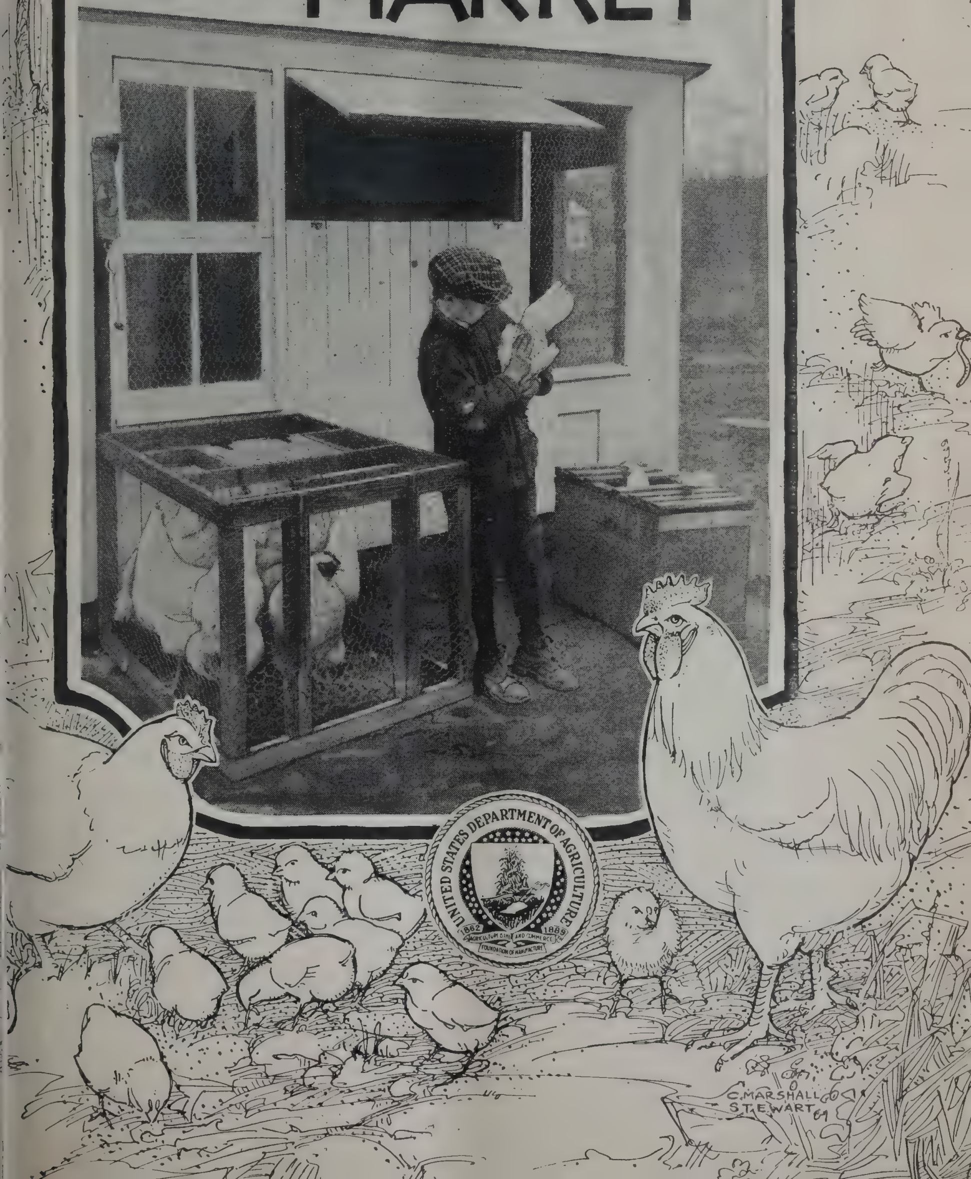
UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 192

B

FARMERS' BULLETIN - 1112
UNITED STATES DEPARTMENT OF AGRICULTURE

CULLING FOR EGGS AND MARKET



THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. August, 1920

CULLING FOR EGGS AND MARKET.

Rob R. Slocum,
Animal Husbandry Division.

CONTENTS.

	Page.
Proper culling insures profit	3
When to cull	3
How to tell the good and poor layers	4
A guide in culling	7
Marketing suggestions	8

PROPER CULLING INSURES PROFIT.

EVERY boy or girl who keeps poultry naturally desires to make as much profit as possible. To do so it is important that every hen kept should be a good layer and that all cockerels except those for breeding purposes (as well as pullets that lack vigor and vitality) should either be eaten or canned for home use or be sold as soon as they are large enough. Selecting or " weeding out " the hens that are poor layers from those that are good layers and picking out for market the cockerels of the flock that are the least likely to develop into good breeders is commonly spoken of as " culling," or culling for eggs and market. If you are to succeed and make money from your poultry it is necessary that you learn to cull your flock accurately so as to keep only such birds as will pay a profit on the feed they eat.

WHEN TO CULL.

The best time to cull the hens is during August and September, (usually from August 15 to September 15), for at that season it is easier to tell which ones have been good layers and which have been poor layers. At that time of the year hens which show signs of laying or are laying and have not molted are usually the ones that have been the better layers during the entire season, and the hen that lays best during her first year will usually lay best during the second and third years. She is, therefore, the one that should be kept. It is not often advisable, however, to keep hens of the heavier breeds, such as Plymouth Rocks, Rhode Island Reds, and Brahmas, beyond their second year, or of the smaller breeds, such as Leghorns, and Anconas, beyond their third year, as they seldom prove profitable.

In addition to culling the entire flock in August and Septembe you should always be on the watch for hens that are sick or ve thin in flesh, or that show signs of weakness or poor vitality. Wh discovered, cull them out at once.

HOW TO TELL THE GOOD AND POOR LAYERS.

There are a number of indications or characteristics that help distinguish a good laying hen from a poor layer. However, they m not all be decisively apparent and all may not agree in the sa fowl. Therefore it is necessary to take into consideration all the di ferent indications and to depend upon the agreement of a majori

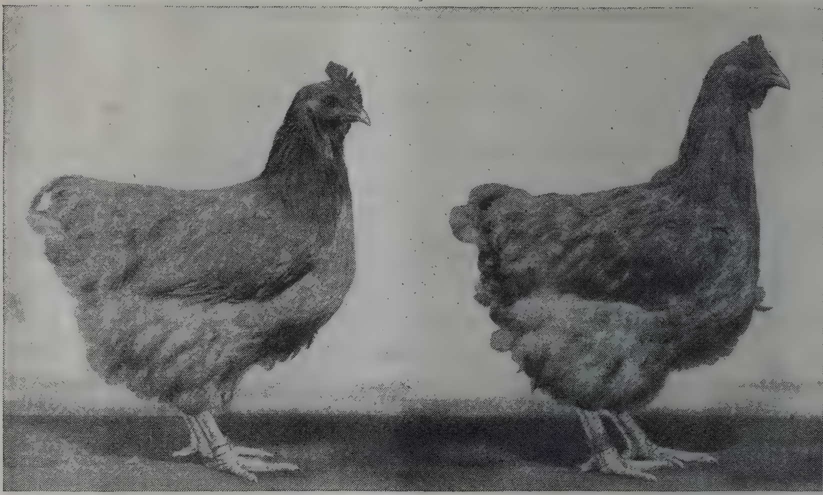
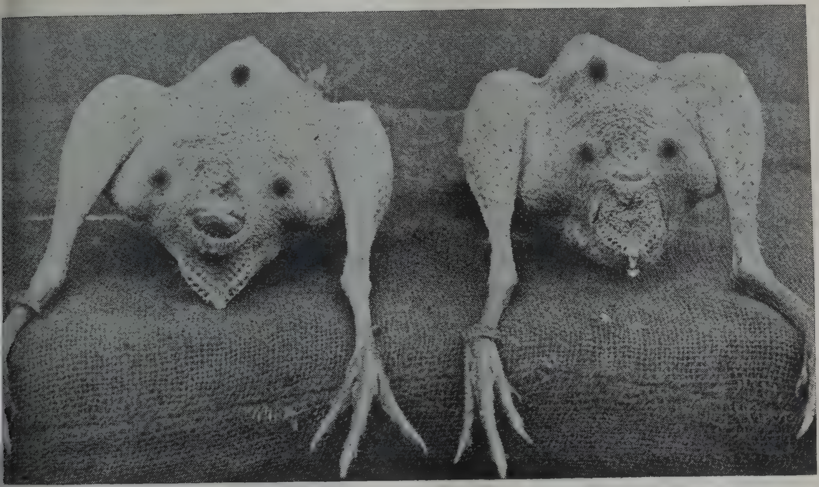


FIG. 1.—(Left) Hen that has not molted in August and September and is still layi which indicates that she is a good producer. (Right) Hen that is molting in Augu and September and has stopped laying, which indicates that she is a poor producer.

of them rather than on only one or two if you are to determine acc rately the good and the poor layers. The following are the princip tests or characteristics, and each one should be considered carefull

Molt.—The manner in which the average hen molts, or, as it sometimes expressed, "sheds her feathers," is almost a self-appli test. It is one of the signs or characteristics that are most noticeab and is a reasonably safe guide to follow, as most hens stop laying nearly so during the time they are molting. The better produce continue to lay late in the fall and therefore do not molt until lat The late molters also molt rapidly as a rule (see fig. 1), while t early molters, which are usually the poor layers, molt slowly. He that have not molted by August or September will show dirty, wor or broken plumage, while those that have molted early show fres clean plumage or growing feathers at this time. It is usually a sable to keep the hens that molt late, particularly if the other ts indicate that they are good producers, as they are almost always e best layers and best breeders, and to discard the early molters, iich are almost always the poor layers.

Shanks and beaks.—The shanks or legs of hens that are naturally llow in color in such breeds as Plymouth Rocks, Rhode Island eds, Wyandottes, and Leghorns are pale and faded in August and ptember if they have been laying heavily. Some will look more ded than others, but all will show a decided loss of color if the hens ve been extra good producers. If the shanks are still yellow in lor the hen is almost sure to be a poor layer. Occasionally, how-



G. 2.—(Left) Hen showing large, moist vent and wide spread between pelvic bones and between pelvic bones and end of keel, which indicates that the hen is laying. (Right) Hen showing small, puckered vent and narrow spread between pelvic bones and between pelvic bones and keel, which indicates that the hen is not laying. The dark spots on each side of the vent in the illustration are used to show the ends of the pelvic bones and the spot higher up the end of the keel.

ver, a poor layer, as well as a sick hen or one in poor condition, will e found with a pale or white shank.

The same rule or principle applies to breeds having yellow beaks, lthough the color fades more quickly from the beak than from the hank. The lower part of the beak bleaches faster than the upper art, but may be used as the guide where the upper half is colored oo much with black or horn color, as is often found in Rhode Island leds.

Vent.—In yellow-skinned breeds the yellow color of the skin close round the vent is lost very soon after the hen begins to lay and eturns again soon after she stops laying. A white or pink vent sually means that the hen is laying, while a yellow vent means that he is not laying. The vent of a hen that is laying heavily is also

large, expanded, and moist (see fig. 2), while that of a hen not la
ing is small, puckered, and dry.

Comb and wattles.—When a hen is laying or nearly ready to la
her comb and wattles are plump, full of blood, somewhat waxy i
feeling, and bright red in color. When she is not laying, the com
is shrunken, pale or dull in color, comparatively hard, and covere
with whitish scales. A dark or bluish color usually indicates sic
ness.

Pelvic bones.—The pelvic bones are the two bones, somewh
pointed (see fig. 2), which can be felt on each side of the ven
When a hen is laying, these bones are rather thin, flexible, and sprea

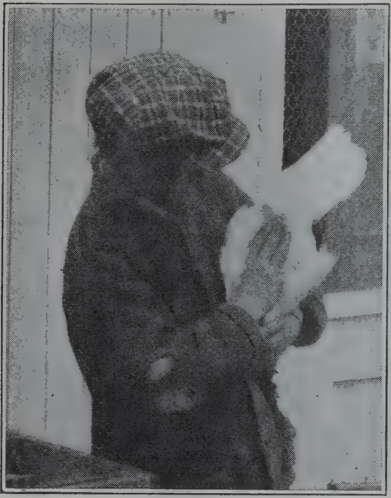


FIG. 3.—Hen showing a spread of three fingers between the pelvic bones, indicating that she is in laying condition.

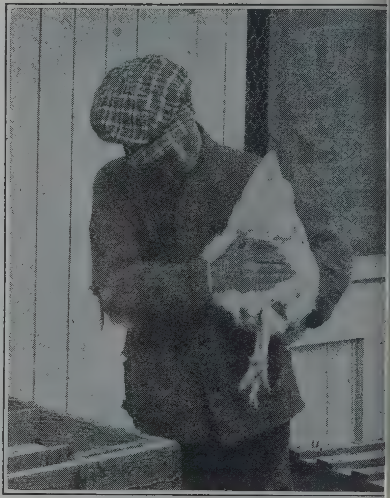
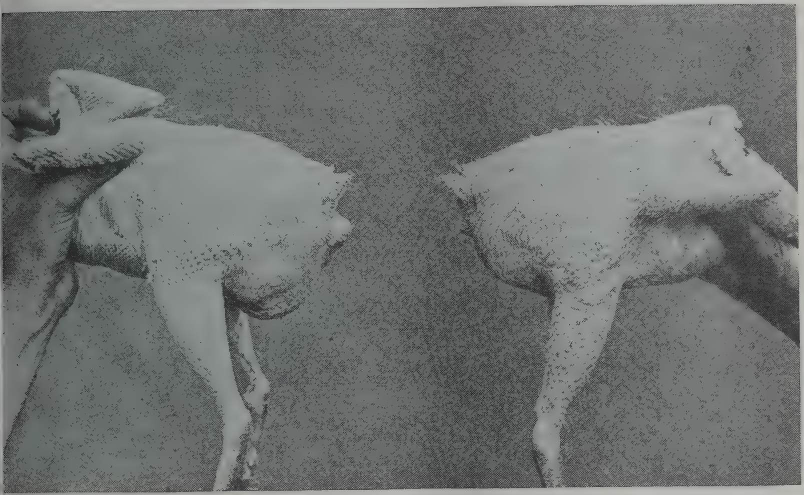


FIG. 4.—Hen showing a spread of more than 4 fingers between the pelvic bones and the rear end of the keel, indicating that she is a good producer.

well apart. When she is not laying they are closer together, fe
thicker, and are less flexible. A hen which shows thick or stiff pelv
bones, even when laying, is more likely to be a poor producer. Th
spread or distance apart of these pelvic bones varies slightly
different breeds, but it is a valuable indication or guide in telling th
layer from the nonlayer. When a hen is laying, a boy or girl shoul
be able to place three fingers of the hand (1½ inches or more) b
tween these bones (see fig. 3), but if she is not laying, the sprea
would probably measure less than 1½ inches or less than three finger
The difference in size of boys' and girls' fingers must always b
taken into consideration.

Size of abdomen.—A hen that is laying well usually eats well, an
therefore her intestines are fuller, more expanded, and require mo
room than when she is not laying and not eating so much. Whe

ing, the egg-producing organs are also of greater size and require re room. To provide this extra room the distance from the pelvic ıes to the rear end of the keel, commonly called the "breastbone," reases (see fig. 2), as well as the size of the abdomen, which is lower rear part of the body shown in figure 3. This distance m the keel bone to the pelvic bones also varies according to the ed or size of the bird, but a hen of the smaller breeds, such as the ghorn, that is laying well should have sufficient room between the l and the pelvic bones to place 4 or more fingers (2½ inches or re), and in the larger breeds the full width of the hand (3 inches more) of the average boy or girl. (See fig. 4.) A smaller distance spread between these bones would indicate that the hen is not ing.



. 5.—The same hens as in figure 2. (Left) Hen showing full, flexible, expanded bdomen, indicating that the hen is laying. (Right) Hen showing hard, contracted, r drawn-up abdomen, indicating that the hen is not laying.

Flexibility of abdomen.—When a hen is laying, the abdomen (see . 5) is flexible or soft, owing to a smaller amount of fat which is rried at this time. When she is not laying, the abdomen is concted or drawn up and is harder and less pliable.

A GUIDE IN CULLING.

To cull out the nonlaying hens from the flock and make sure that is done correctly requires considerable care in applying the different tests. For that reason boys and girls are urged to study very refully the instructions given in this circular so as to become miliar with them all, if the work is to be done thoroughly and well. brief, the hens to cull and the hens to keep are described in the o following paragraphs, but in every instance several of the different tests or characteristics should agree, and a hen should not b selected or discarded by any one characteristic alone.

The hens to cull.—Cull all hens that are sick, weak, inactive, lacking in vigor, poor eaters, with shrunken, hard, dull or whitish-colore comb; with thick, stiff pelvic bones that are close together; sma spread or distance between rear end of keel and pelvic bones; ful firm, or hard abdomen; and those that have molted or begun t molt in August or September. In breeds having yellow legs and ski the discarded hens should also show yellow or medium-yellow leg and yellow beaks and vents.

The hens to keep.—Keep the hens that are healthy, vigorou active, good eaters, with plump, bright-red combs; large, mois vents; thin, pliable pelvic bones spread well apart; a wide spread between pelvic bones and rear end of keel; large, soft, pliable abdomen and neither molted nor molting in August or September. In breec with yellow legs and skin the hens kept should also show pale c white legs and pale or white beaks and vents.

MARKETING SUGGESTIONS.

Hens and cocks.—As soon as the culling is finished, which shoul be during August and September, all hens culled out or discarded a poor producers or nonproducers should be marketed at once. No he regardless of age or breed, should be kept after you have found ou that she will not pay a profit. Cock birds not wanted as breede should be marketed immediately after the hatching season is ove

Cockerels.—All cockerels raised each season except those select to keep for breeders should be eaten, canned, or marketed just a soon as they are large enough. If the chicks are hatched earl the cockerels should reach broiler size in June or July, when the is a good demand and prices are high. Cockerels saved for breede should be vigorous, strong, active, and alert, and those that ha grown most rapidly and are the best developed. If a bird does n possess these qualities he will not make a good breeder.

Pullets.—Pullets that are weak, undersized, and poorly develop should also be eaten, canned, or marketed, as they will not mal profitable producers; but no thrifty, well-developed pullets shou ever be disposed of in this way, for it is these pullets when kept f layers and breeders that will net the greatest profit.

○

FARMERS' BULLETIN · 1113

UNITED STATES DEPARTMENT OF AGRICULTURE

POULTRY HOUSES

THIS BULLETIN has been written briefly and in simple style for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs. For additional and more complete information the reader should ask for Farmers' Bulletin 574, "Poultry House Construction," which may be obtained in many cases from local club agents or will be sent free of charge on application to the United States Department of Agriculture, Washington, D. C.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. August, 1920

POULTRY HOUSES.

ALFRED R. LEE,
Poultryman, Animal Husbandry Division.

CONTENTS.

	Page.
ocation	4
oor space	4
ouse for small flock	4
ouse for 50 to 75 hens	5
Remodeling poultry houses	6
Floors	6
Interior arrangement	7

POULTRY HOUSES or other buildings where fowls are kept should be dry, well ventilated, free from drafts, with plenty f sunshine and room enough to allow the birds to move about with reedom and comfort. These are necessary factors, in fact much more important than the kind or style of building used, if the fowls re to be kept healthy, vigorous, and productive. Poultry houses re built in a variety of shapes and sizes, and often old buildings are built over or remodeled into poultry houses, all giving about the same results, which indicates that no fixed type of building can be recommended as superior to all others if proper ventilation, light, and other essentials here referred to are provided.

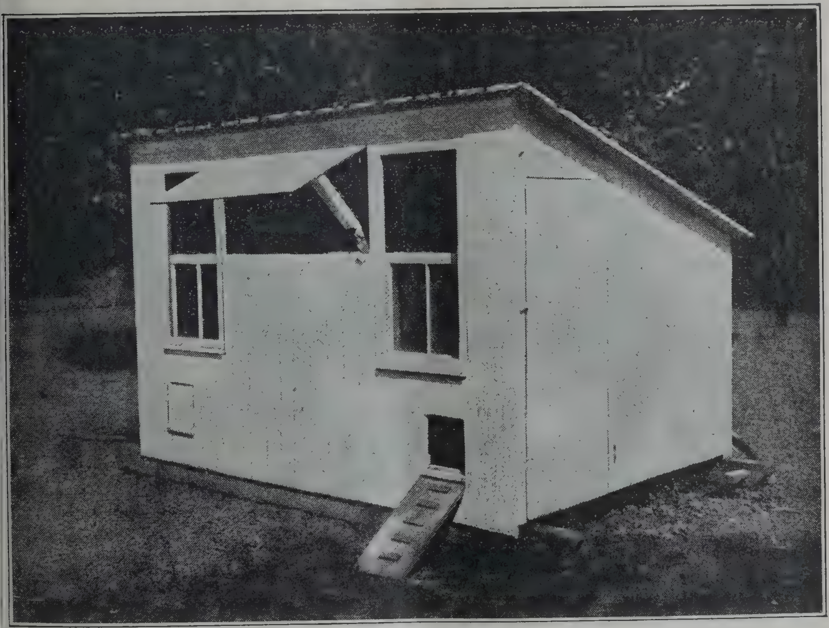


FIG. 1.—House for small flock. It will accommodate any number of fowls up to 25.

LOCATION.

If new houses are to be built they should be located if possible o high or sloping ground and always on dry and well-drained soil Wet or damp ground means a damp house and a damp house not onl means a cold one but invites sickness and diseases. Never build house in a hollow, as water and cold air settle in low places an should be avoided. Have the house face the south, as it gives mor sunlight and for a longer part of the day, especially in winter, whe sunlight is necessary for the comfort of the birds. It also makes th house warmer, drier, and more cheerful and adds to the productiveness of the flock.

FLOOR SPACE.

The poultry house should be convenient, substantial, and inexpensive. Its size or dimensions depend largely upon where you liv and the number of fowls you wish to keep. On a farm or where th birds can be out of doors nearly every day in the year, about 2 square feet of floor space per bird in flocks of 20 is enough, but i a village or city or in a climate where there is a good deal of snow making it necessary to confine the birds closely, 4 or 5 square fee per bird should be allowed.

HOUSE FOR SMALL FLOCK.

The house shown in figure 1 is a very satisfactory one for th average boy or girl who wishes to keep only a small flock, as it ma be used for breeding birds or for hens kept only for egg production It is 10 feet long, 7 feet wide, 6 feet 2 inches high in front and 4 fee high in back, and will accommodate any number of birds up to 25 The following lumber was used in its construction:

Description of material.	Feet b. m
2 pieces 4 by 6, 12 feet long, for sills	4
3 pieces 2 by 4, 14 feet long, for joists	2
3 pieces 2 by 4, 16 feet long, for rafters	3
13 pieces 2 by 4, 12 feet long, for studs and braces	10
340 square feet $\frac{7}{8}$-inch matched flooring for floors and sides	34
100 square feet 1-inch sheathing for the roof	10

Also 1 roll of roofing paper, 2 windows, wire for windows, hinges, and nails.

Common boards 1 inch thick may be used instead of matched flooring for inclosing the house, but in that case battens should b placed over the cracks. Boards as wide as possible should be used, as the wider the boards the smaller the number of battens required. The use of battens is somewhat cheaper and just as satisfactory, although the house is not quite so attractive.

---

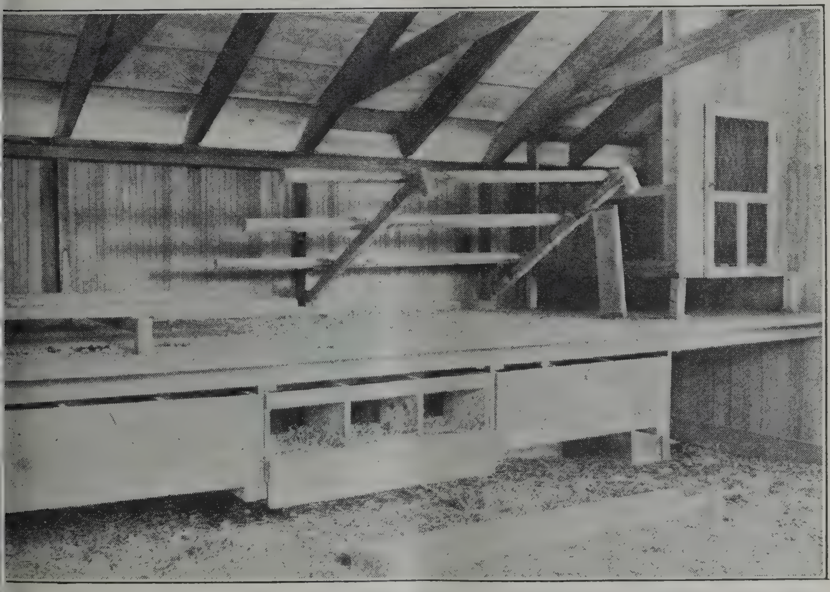
[1] NOTE.—In some parts of the South "stick-tight fleas" are very troublesome. These fleas breed rapidly in the dry sand or dirt, but will not live or breed in damp places. Therefore, where dirt floors are used the poultry houses are often built in rather low damp places (not wet) in preference to a high, sandy, dry location.

In a climate where the winters are not exceptionally cold it is referable to cut one large opening in the front of the house instead 2 windows and the opening between them, as shown in figure 1, d to cover it with wire netting instead of putting in sash and glass. hen this is to be done, cut the opening lengthwise of the buildg 7 feet long, 2½ feet wide, and 6 inches from the roof. Such an ening provides an abundance of ventilation, fresh air, and sunine, which are very necessary. If it is too cold, a burlap curtain ay be made to put down over the opening at night and on exemely cold days. A hen will stand a good deal of cold air, hower, provided the air is dry, and plenty of ventilation helps to eep the air dry in the house.

The house shown in figure 1 was built on runners so it could be oved to fresh ground occasionally, but if desired it may be put n a permanent foundation, and the runners left off.

HOUSE FOR 50 TO 75 HENS.

The boy or girl who wishes to keep a larger number of hens must ecessarily provide a larger house. If kept principally for egg prouction, from 50 to 75 hens may run together with good results, and or this number a house of the same type as figure 1, but 16 feet ong, 12 feet wide, 8 feet high in front and 5 feet high in back, is ecommended. Such a house gives 192 square feet of floor space



IG. 2.—A good interior arrangement for a poultry house, showing roosts and dropping boards with nests beneath and a wire coop at the end for confining broody hens. Note ventilators in back of house and the abundance of sunlight, which insures a dry house and healthy fowls.

and will accommodate from 50 to 60 hens of the larger breeds, suc as Rhode Island Reds or Plymouth Rocks, and from 60 to 75 of t smaller breeds, such as Leghorns, Anconas, and Hamburgs, depen ing upon how much the birds can be out of doors.

Breeding pens.—The club member who wishes to separate his bir into small breeding pens can divide his house into two or more suc pens by constructing wire partitions. The interior arrangeme of a good-sized pen with dropping boards, roosts, and nests is show in figure 2.

REMODELING POULTRY HOUSES.

Many farms have old-style closed-up poultry houses with po light and ventilation, also old sheds and other buildings of little u for other purposes, that can be remodeled or built over with litt difficulty into satisfactory poultry houses. If poultry-club membe are offered such an opportunity they should take advantage of for a building of that kind usually can be made over for less than on half the cost of constructing a new one and if the work is well do should give just as good results. Furthermore, the work pe formed in remodeling the building serves as a good poultry-cl demonstration in poultry-house construction. The upper left-ha picture of figure 3 shows an old-style house, lacking in both light a ventilation, and thus unfit for keeping fowls. The upper picture the right shows an old shed as it appeared before it was bui over into a poultry house. The two middle pictures show differe views of the same shed remodeled or built over into a modern hous The lower left-hand picture shows the interior of the house, and t lower right-hand picture shows the completed house after a coat whitewash had been applied.

FLOORS.

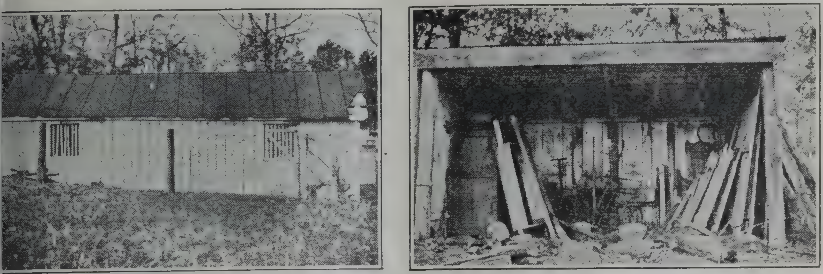
Poultry houses may be built with or without floors. In either ca they should be dry, as damp floors make damp litter, and dampne is fatal to both fowls and chicks.

If the house is on dry sandy soil, a dirt floor is usually quite sati factory, but as a rule it is more damp than board or cement floo Dirt floors should be scraped down to the clean soil and fresh grav or sand put in once a year to keep them sanitary. If board floors a used they should be both tight and smooth so as to make them d and easy to clean. If possible they should be 8 or 10 inches from t ground to allow a circulation of air and to prevent rats from harbori under them.

Cement floors.—Cement floors, especially for large houses, are qui satisfactory, as they keep rats out and also last much longer th board floors. They are also sanitary and easy to clean. A ceme or should always be kept well covered with litter; otherwise it is ld and uncomfortable for the birds.

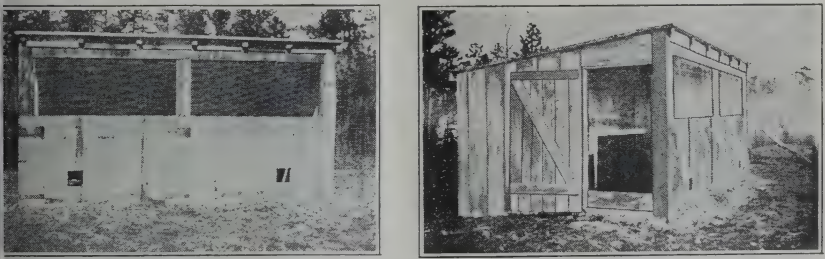
INTERIOR ARRANGEMENT.

The interior of each poultry house should be simple, convenient, d easy to clean. About the same arrangement can apply to any



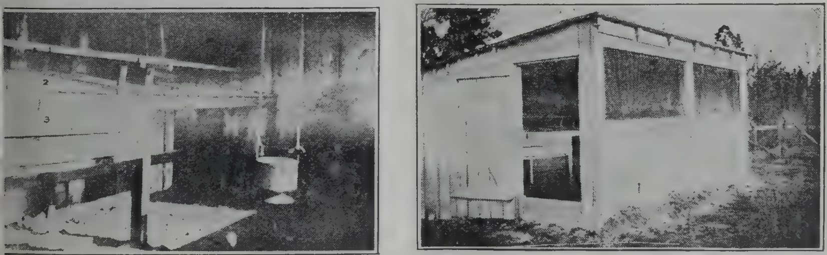
l-style henhouse. No light; no ventilation; poor results.

Old shed. Excellent material for poultry house.



en-front henhouse. Shed boarded up in front; poultry-netting windows.

Side view of house constructed from old shed.



terior of same house. Good sunlight conditions. 1, Movable roosts; 2, dropping board; 3, nests.

Model henhouse constructed from shed at little cost. Note effect of a coat of whitewash.

FIG. 3.—How old buildings may be converted into good poultry houses.

ouse, the only difference being that the larger the number of fowls ept the more nests and roosting room required.

Roosts.—Always place the roosts in the back of the house away om the windows or openings to avoid cold. To catch the droppings, uild a platform or dropping boards (see fig. 2) about 2 feet or feet 6 inches from the floor (never more than 2 feet 6 inches) and ave the roosts about 8 inches above the dropping boards and 15 ıches apart.

From 8 to 10 inches of roosting space should be allowed for eac hen. The roosts should be built as shown in the picture (fig. 2 and hinged to the back wall, so that they may be raised and bot roosts and dropping boards cleaned and sprayed thoroughly. A roosts should be of the same height. Never build one above the othe as every hen will try to get on the highest roost and will fight an try to crowd the others off.

Figure 2 also shows at the end of the roosts a small coop inclose with wire and having a slat bottom for confining broody hens. Suc a coop may or may not be included with the other fixtures, as th club member may wish. If built it should be 3 or 4 inches above th platform, as shown in the picture, because it is easier to keep clea and also allows air to circulate underneath and through the slat which is important in breaking up sitting hens. If this brood coo is not built, a small slatted coop or crate suspended from the ceilin by a wire or rope, allowing it to swing, makes a good place to brea up broody hens.

Nests.—There should be a nest for every 4 hens. Nests should b at least 15 inches square, and may be built singly or in rows an fastened to the side of the building or placed under the droppin boards, as shown in figure 2. If possible, however, nests should b somewhat secluded or darkened, as the hens seek such nests mor readily and are also less liable to acquire the habit of eating thei eggs. The entrances to the nests in the picture are from the bac the door in front being for convenience in gathering the eggs.

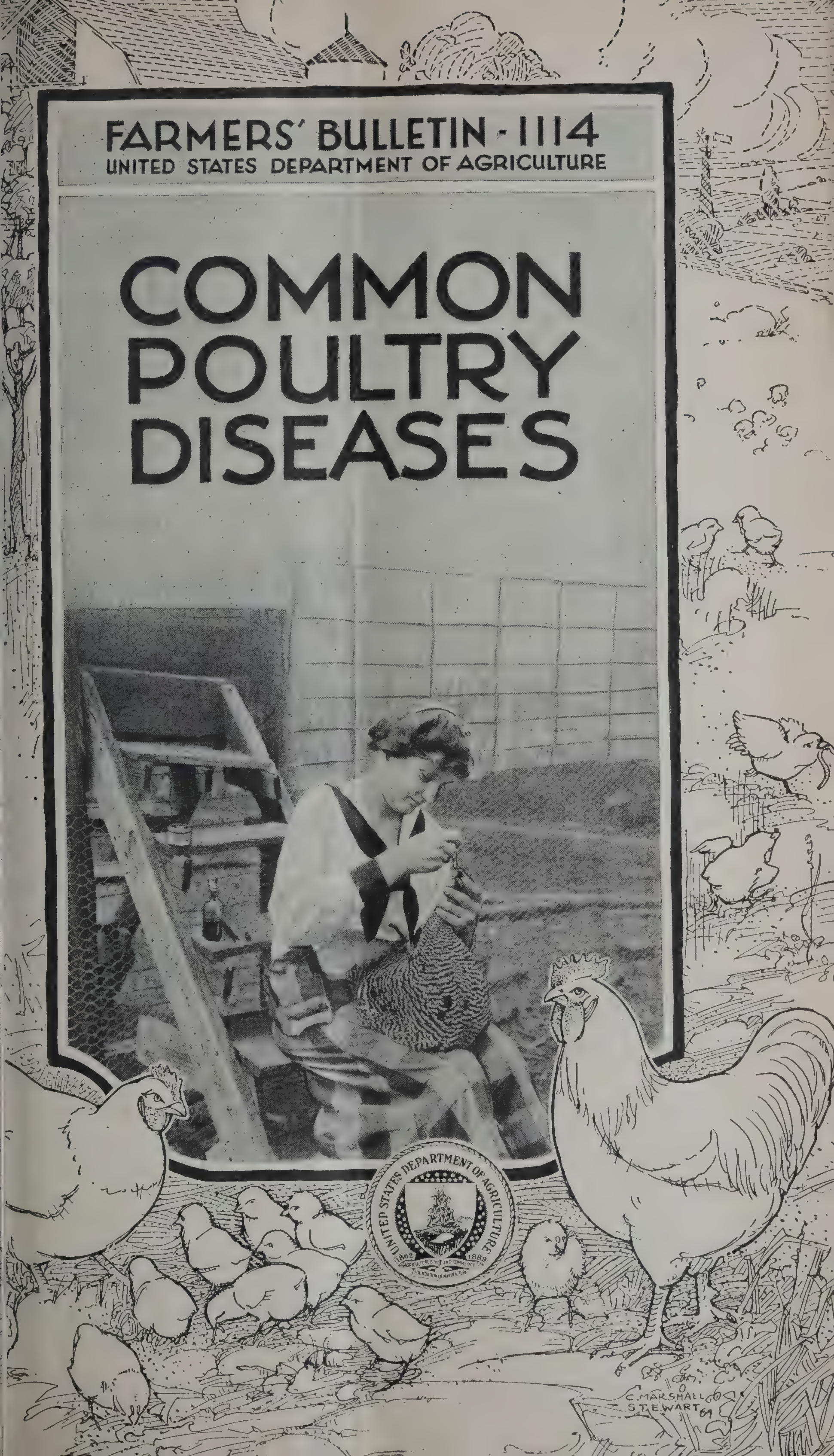
Litter.—The floor of every poultry house, whether of dirt, board or cement, should be kept covered with a litter from 3 to 6 inches dee at all times. Oat, wheat, or rye straw makes the best litter, but if i can not be obtained sawdust, chaff, dry leaves, or pine needles ma be used. As soon as the litter becomes damp or badly soiled it shoul be taken out and fresh, dry litter put in its place.

FARMERS' BULLETINS FOR MEMBERS OF BOYS' AND GIRLS' POULTR CLUBS.

574. Poultry-House Construction.
1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1110. Lice, Mites, and Cleanliness.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.
1116. The Selection and Care of Poultry Breeding Stock.

FARMERS' BULLETIN · 1114
UNITED STATES DEPARTMENT OF AGRICULTURE

COMMON POULTRY DISEASES



THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs. For additional and more complete information on the subject the reader should ask for Farmers' Bulletin 957, "Important Poultry Diseases." This may be obtained in many cases from club leaders or will be supplied free of charge on application to the United States Department of Agriculture, Washington, D. C.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. Issued August, 1920

COMMON POULTRY DISEASES.

D. M. Green,
Animal Husbandry Division.

CONTENTS.

Page.
pes 3
up 4
cken pox 6
ly leg 6
vention better than cure 7

DISEASE is one of the handicaps to successful poultry keeping and should be guarded against at all times. Unless kept in a ealthy condition, chicks will not grow properly, and mature fowls ill lose their vigor and vitality and become unproductive and nprofitable.

It is far better to prevent disease by proper care and attention than attempt to cure a bird after it is sick. Therefore it is important to atch the flock closely at all times for any signs of disease, so in case n outbreak occurs it may be checked at once. Prevention is always etter than cure, and all boys and girls who wish to succeed in poultry-ub work should try to give their birds such good care and keep their ouses so well cleaned and disinfected that both fowls and chicks ill keep hardy and vigorous and allow no opportunity for sickness creep in.

Some diseases may be treated successfully, while others of a more erious nature usually are fatal. However, if only one or two birds f a flock become sick it is usually advisable to kill them immediately nless they are choice specimens) and burn or bury the carcasses. f the birds are kept and an attempt is made to doctor or cure them he disease may prove contagious and spread throughout the entire ock.

The more common poultry diseases and those which poultry-club nembers are likely to find most troublesome are gapes (in young hicks), roup, chicken pox, and scaly leg.

GAPES.

The disease known as gapes, which is quickly noticed because of the neezing and gaping of the chick, affects only young chicks and young urkeys, and usually develops during the first few weeks of their lives.

It is caused by a little worm which attaches itself to the inside of th windpipe, where after a few days it will increase in numbers to suc an extent as to obstruct or stop up the windpipe, making it difficul for the chick to breath, and unless the worms are removed at onc it will soon strangle, choke, and die. The female worm produce large quantities of eggs while in the windpipe, and these are throw out by the chick in sneezing, or are swallowed, pass through the intestines, and are scattered with the droppings. After a few days youn worms hatch from these eggs and live in the earth for a long time. I picked up and swallowed by young chicks they quickly find thei way to the windpipe, develop, and cause the disease to appea This explains how infection is carried over from one year to anothe and why ground used year after year becomes so infested or fille with these little worms that chicks can not be raised upon it.

Treatment.—Take a long hair from a horse's tail and twist th two ends together so as to form a loop. Hold the chick's hea firmly with one hand, with the neck out straight, forcing the bea open with the fingers. When the glottis, which is the little openin at the root of the tongue, is open for breathing, insert the loop en of the hair, pressing it down the chick's windpipe about 1 inch Give it two or three turns and then withdraw it. This will usuall bring out several of the worms. Make sure that the hair is ru down the windpipe and not down the chick's gullet. Each tim the hair may be inserted a little deeper until it reaches nearly th full length of the neck, extreme care being taken not to choke o injure the chick. All worms taken out should be shaken off th hair and scalded or burned.

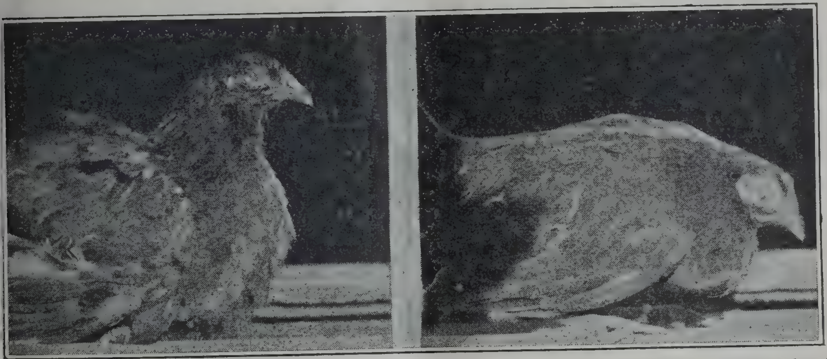
Prevention.—The best preventive for gapes is to keep the chick on fresh, clean soil at all times. If they become affected with th disease, remove them at once to fresh ground where there is plent of green grass. Ground occupied by chicks affected with gape should be covered with a thick coating of lime and then spaded u thoroughly or plowed to destroy any worms that may possibly exist Chicks should not be raised on the same ground again for at leas two seasons.

ROUP.

Roup is a disease which affects the eyes, nose, and throat. Th first signs are watery eyes, swollen eyelids, loss of appetite, and thin, watery discharge from the nostrils; after a few days the discharge becomes thick and interferes with the bird's breathing. I severe cases the side of the bird's head is hot and badly swollen an the eyelids stuck together with a yellowish, cheesy substance.

Roup frequently develops from a hard cold, but more often i brought into the flock by other birds that have had the diseas have been exposed to it. It is very contagious. The saliva or scharge from the mouth and nostrils carries the germs, and if the ck birds are allowed to remain or eat or drink with the others ıe disease will spread very quickly throughout the flock. Birds ıat are out of condition or lacking in vitality are usually the first ıes to become affected and the last ones to recover, and sometimes ırry and spread the disease for several months after they appear be cured.

Treatment.—The sick birds should be removed at once from the ock and put into warm, dry quarters where there is plenty of fresh ir but no drafts. Take some warm water, add a little salt (about ne teaspoonful to a quart of water), and carefully wash the eyes nd mouth, using a soft cloth or a piece of absorbent cotton. It is lso well to rub or massage about the nostrils and under the eyes to osen any of the watery discharge or secretion that may have accumulated there. After cleansing take two heaping teaspoonfuls one-half ounce) of boric acid, or a small half-teaspoonful (1 dram) f permanganate of potash, which can be purchased at almost any rug store, dissolve in 1 pint of water, and wash the eyes and mouth horoughly; or dip the bird's head into a bowl of the solution, repeating the treatment two or three times daily. A tablespoonful of peroxid of hydrogen mixed with 2 tablespoonfuls of water and injected into the bird's nostrils (see illustration on front cover) with a small oil can or medicine dropper is very beneficial. After the bird has been treated in this manner grease the head with camphorated oil or carbolated vaseline. It is also advisable to put a small quantity of permanganate of potash into the drinking water, as it helps to prevent the disease from spreading. In very severe cases it is best to kill the bird at once, as seldom, if ever, can it be fully and permanently cured.



IG. 1.—(Left) Hen showing first stages of roup. The eye is swollen and watery and the eyelids closed. (Right) Hen showing advanced stages of roup. Eyes and head swollen, eyelids closed, and the bird weak and droopy from loss of appetite.

Prevention.—Keep the house clean, well ventilated, and disinfected. Be sure that the birds are not exposed to drafts so as to catch cold. Fowls or chicks purchased from other breeders should be put into a separate house. If this is not possible, watch each specimen closely for two or three weeks for any sign of the disease, so that if it appears the bird may be removed before the others are affected.

CHICKEN POX.

Chicken pox (sometimes called sorehead) is another very contagious disease. It makes its appearance in the form of irregular whitish patches or festers which later develop into brown spots or crusts (resembling a scab of a sore) on the comb, wattles, eyelids, and around the beak and nostrils. In severe cases these patches or sores increase in numbers to such extent that the birds have difficulty in opening their eyes and beaks, and if neglected many will die.

Treatment.—Apply a liberal quantity of carbolated vaseline to all the affected parts. This treatment after a short time will cause the patches or crusts to soften and drop off, when the tissue or sore underneath should be painted with tincture of iodin or 5 per cent solution of carbolic acid. Five pounds of fine-powdered sulphur mixed with each 100 pounds of dry mash is also beneficial in effecting a cure. As soon as the disease makes its appearance spray the houses and coops thoroughly with some good disinfectant (preferably some wood preservative or coal-tar preparation), and scald the drinking fountains and feed dishes thoroughly with boiling water. Repeat every two or three days until after all the birds have fully recovered.

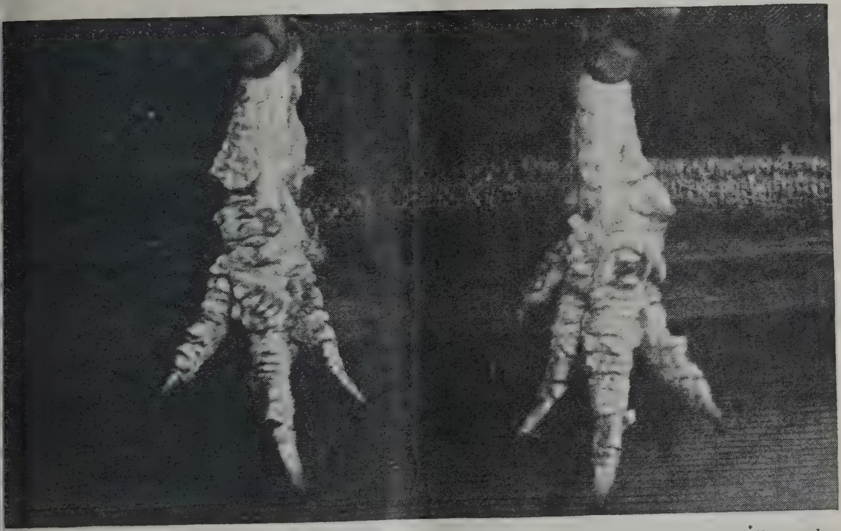
Prevention.—Keep all roosting quarters clean, dry, and well disinfected. During the summer, when the disease is most common, mix 3 pounds of powdered sulphur with each 100 pounds of dry mash, allowing the birds to eat all they want. Chicken pox usually attacks late-hatched chicks more often and more severely than early hatched ones, which makes it advisable to hatch as early in the season as possible.

SCALY LEG.

Scaly leg is easily recognized by the enlarged, roughened appearance of the feet and legs. It is caused by a little mite which burrows beneath the scales and causes the formation of a yellowish, powdery substance which keeps raising up the scales until they present an unsightly appearance. In severe cases, if the birds are not cared for, the joints of the toes become inflamed and make the birds lame and sometimes unable to walk. The disease is contagious, although it spreads rather slowly.

Treatment.—Wash the bird's legs well with soap and warm water and remove all loose scales. Rub well with a half-and-half mixture kerosene and linseed oil (melted lard or vaseline may be used in ace of linseed oil), or fill a can with the mixture, and at night, after e birds have gone to roost, dip each bird's legs into it and allow them soak for a minute; then return the bird to the roost. Repeat e treatment every three or four days until the scales are removed. l of caraway used in the same manner is also very effective.

Prevention.—Spray the roosts, dropping boards, and all near-by acks and crevices thoroughly and often so as to keep them free om mites. Examine the bird's shanks occasionally, and if any gns of scaly leg appear rub them well with oil, as directed above, prevent the disease from developing.



IG. 2.—Legs of hen badly affected with scaly leg. Note the rough, loose appearance of the scales caused by the mites burrowing underneath.

PREVENTION BETTER THAN CURE.

Remember that it is much easier to keep birds healthy and well han to cure them after they are sick. Club members are therefore rged to guard against disease by giving their fowls and chicks proper are at all times. Keep in mind the following: Lice, mites, filth, poor eed, dirty water, damp houses, drafts, and lack of care and attention reed disease. Sunlight, fresh air, clean houses and runs, good feed, resh water, and good care and attention mean health, vigor, and profits.

For information regarding other poultry diseases write to United States Department of Agriculture, Washington, D. C., for Farmers' Bulletin 957, "Poultry Diseases," or ask your poultry-club leader to obtain a copy for you.

THIS BULLETIN has been written briefly and in simple terms for beginners, and especially for members of Boys' and Girls' Poultry Clubs.

Poultry exhibitions are not only of educational value but encourage the desire to excel in producing a high quality of stock.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief

Washington, D. C. September, 1920

ELECTION AND PREPARATION OF FOWLS FOR EXHIBITION.

Jos. Wm. Kinghorne,
Animal Husbandry Division.

CONTENTS.

Page.
lue of poultry exhibitions 3
lecting the fowls 3
eparation 5
ipping the fowls 9
tending the show 10

VALUE OF POULTRY EXHIBITIONS.

THE EXHIBITING of poultry by the members of boys' and girls' poultry clubs should be considered the final achievement the year's work, showing, as it would, what was accomplished uring that period by the club members. Poultry shows, whether eld as exclusive exhibits of poultry or in connection with a State, unty, or community fair, are not only of much interest to the ublic but likewise play an important part in the development of e poultry industry. In order to win at a poultry show, fowls must nform to the standard requirements for the breed. Other things eing equal, such birds are desirable both as producers and as reeders.

Members of poultry clubs should therefore be eager to exhibit their wls whenever the occasion presents itself, to put forth every effort demonstrate to the public what they have accomplished, and, kewise, to compete among themselves for prizes and awards. The onor and distinction of winning a prize are of greater value than e amount of money actually won. There should exist a keen nse of rivalry and competition between club members to see who has roduced the best birds.

SELECTING THE FOWLS.

The selection of the fowls to be shown should begin soon after the hicks are hatched, for unless the chicks are properly grown and ed that they may mature into typical representatives of their breed ey can not be considered as likely candidates for the exhibition. he first actual selection of the birds to be shown should be made y carefully observing the fowls as they appear in the yard or on range. This should happen not less than a month, or better two months, before sending them to the show. While making such observations members of the poultry club should keep in mind the general characteristics of the breed of the birds that are to be exhibited.

Every flock will include individual birds that are outstanding in their appearance, that possess the desirable type for the breed, as well as desirable color of plumage. These better-appearing birds should be caught and carefully examined in detail for undercolor, surface color, and for defects and desirable points described in the American Standard of Perfection.[1] In choosing the candidates for the show it should be kept in mind that no fowl is perfect, and tha the selection is largely a matter of picking those with the leas defects and the most desirable characteristics.

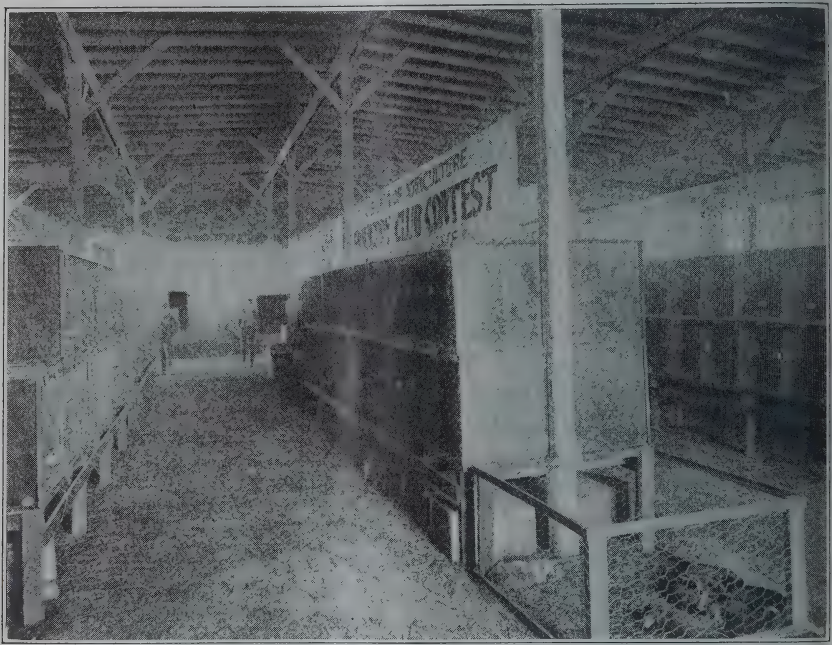


Fig. 1.—A poultry-club exhibit. With the development of club work there is much competition which results in many entries of excellent fowls.

Birds that possess absolute disqualifications for the breed o variety to which they belong should not under any circumstance be sent to the show, for fowls having these disqualifications will no even be considered for a place among the winners. In addition t the standard requirements as called for, consideration in makin the final decision should be given to the health, vigor, and genera appearance of the bird.

---

[1] The American Standard of Perfection is a book published by the American Poultr Association, Fort Wayne, Ind.

PREPARATION.

Training and conditioning.—Boys and girls should realize that the rd that has been properly trained and prepared will stand a better ance of winning a prize than another bird equally good, but which wild or easily frightened, or whose plumage is soiled or dirty.

The birds selected should be removed from the rest of the flock d each bird placed in an exhibition coop for at least a portion of ch day. Fowls so confined will become accustomed to the coop. andling them—that is, removing them from the coop each day— ill have the effect of making them tame. In handling the birds and emoving and returning them to and from the coops, move quietly nd handle the birds gently so as not to frighten them. When andling fowls, hold them as shown in figure 2. Examine the lumage so that the fowl will become accustomed to such movements hen being handled by the judge. Likewise, attempt to compose he bird by smoothing and stroking the wattles gently; this seems o have a soothing effect on the fowls, and when done frequently nd properly they come to look for it when one approaches the coop.

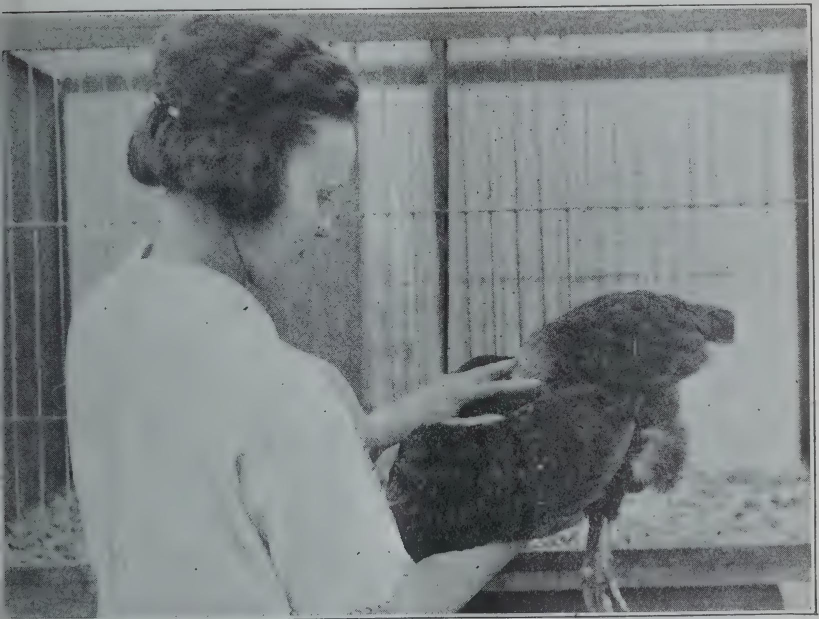


FIG. 2.—A club member examining the undercolor of a Rhode Island Red pullet.

Those that are to be exhibited should not be confined to the exhiition coops for too great a period, as long, continuous cooping may ause them to get out of condition and therefore unfit for show. A satisfactory plan is to confine the birds for a part of each day o every other day alternately up to a few days before sending the to the show, when they should be confined until ready to ship.

Washing the plumage.—All white varieties of fowls, such as th White Leghorns and White Plymouth Rocks, and those having considerable white plumage, such as Columbian Plymouth Rocks an Light Brahmas, and even the buff varieties, should be washed i order to make the best possible showing when exhibited. Dark-colored fowls, such as Rhode Island Reds and Barred Plymout Rocks, need not be washed unless their plumage is considerabl soiled. The head, feet, and shanks, however, of all varieties shoul be properly cleaned as described later. The actual washing of bird is not a difficult operation, and with a little practice boys and girl will soon become proficient in the work. Before attempting to wash the birds that are to be shown, select from the flock two or three fowls that are not going to be exhibited and wash them as described herein so as to gain confidence and practice before washing those that are to be shown.

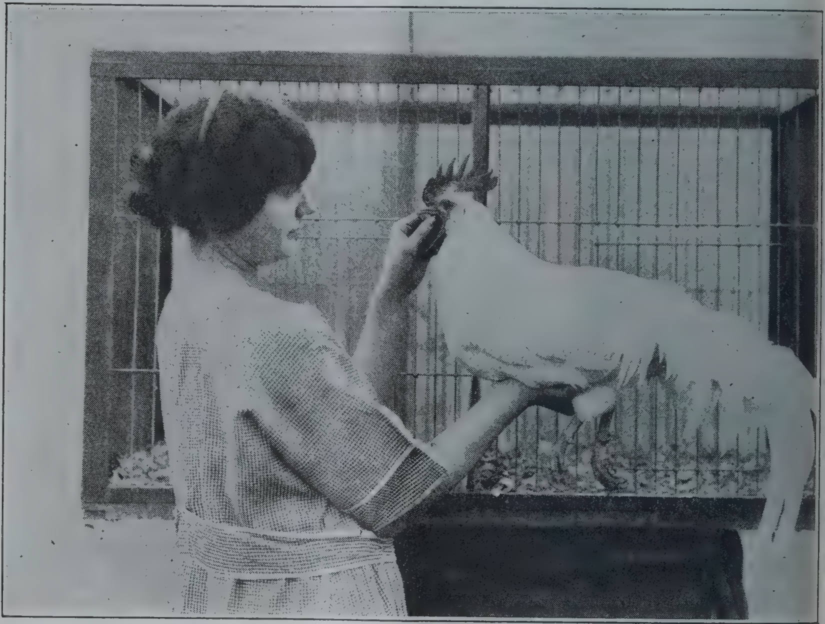


FIG. 3.—This poultry-club member is closely examining the head parts of her White Leghorn male for defects.

The birds should be washed in a room or building where the temperature is from 70° to 80° F. and in a place that is free from drafts. The washing should be done in the morning so that the birds may have time enough to dry completely before night.

Before washing the birds place the exhibition coops a short dis- ance from a stove or other source of heat so that the birds will dry f readily after being washed. Place clean shavings in the coop, nd cover the top, back, and sides of the coop with cloth or paper to revent a draft. The front of the coop should be left open. Get ree or, better, four tubs and arrange them on a bench or platform f convenient height. The water in the first tub is to be used for e actual washing and cleaning; the second, third, and fourth tubs re used for rinsing or removing all the soap. Each tub should ontain water enough to cover the body of the bird when immersed, r in other words, it should be about two-thirds full. If possible to btain it, clean rain water should be used. Hard water will not pro- uce so satisfactory results as soft water.

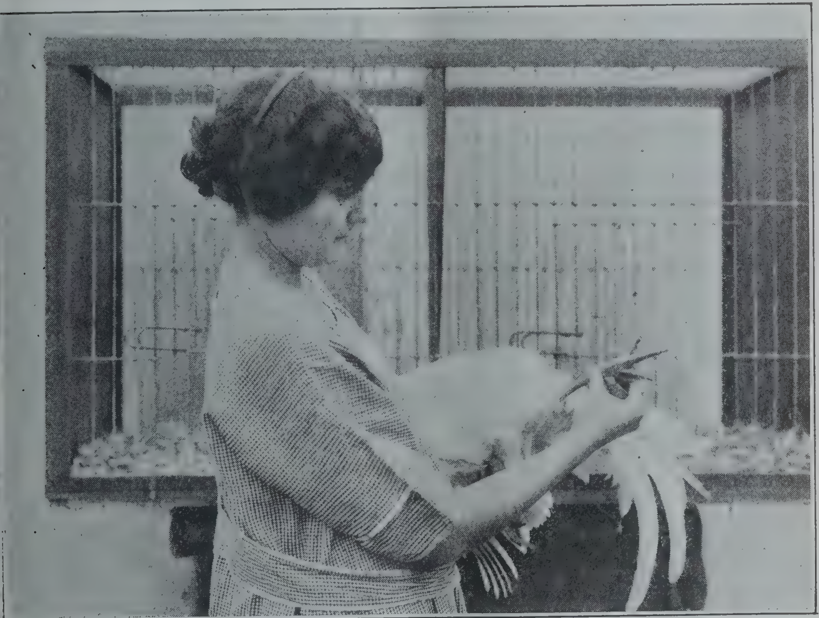


Fig. 4.—The feet and shanks should be examined for stubs or small feathers, which are disqualifications when found on breeds that should have clean, unfeathered shanks.

Any pure white toilet soap may be used for washing. The water n the first two tubs should be heated to a temperature that will be omfortable to the hand, while the water in the third and fourth tubs ay be slightly cooler. Before beginning to wash the fowl, soap the ater in the first tub well, so that there will be plenty of suds floating n the surface; next, wash the face, comb, wattles, shanks, and feet f the fowl by scrubbing these parts with a small nailbrush and lenty of soap and water. Before actually rubbing the feathers of he fowl be sure that the water has thoroughly penetrated all sections of the plumage so that the bird is soaked to the skin. Next, apply the soap by working up, with the fingers, a good lather through all sections of the plumage of the fowl.

Rub the lather with the feathers instead of against them. A small sponge helps considerably in applying the lather and in cleaning the wing and tail feathers. Should the feathers, especially those of the tail and wings, be very dirty the nailbrush can be effectively used. If after the first washing the plumage seems still to be dirty it will be advisable to shampoo the feathers thoroughly a second time before transferring the fowl to the second tub. Remove as much of the soap as possible from the bird before immersing it in the second tub. The operator should realize the importance of completely removing all the soap from the feathers in the second, third, and (when used) the fourth tubs. When even a trace of soap is left in the feathers it will cause them to appear streaked and to be matted together when dry. In rinsing the feathers be sure to see that the water penetrates all parts of the plumage. After four or five fowls have been washed, change the water in all the tubs before washing additional fowls.

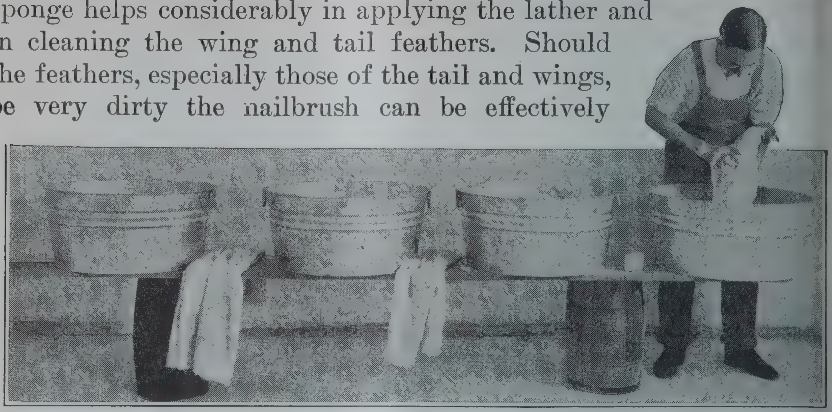


FIG. 5.—Washing, when properly done, adds greatly to the appearance of the birds.

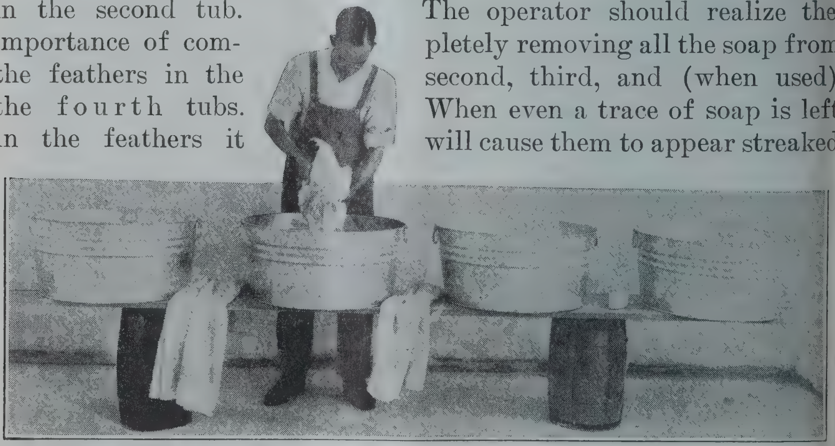


FIG. 6.—Rinse the birds thoroughly so as to remove all the soap after washing.

Drying the fowls.—On removing the fowl from the final tub remove the surplus water from the feathers by blotting the surface of the feathers with a Turkish towel. Do not under any circumstances rub feathers with the towel, for it may do considerable damage to plumage. Next, place the bird in one of the coops previously scribed. Should the fowl appear cold and shiver when placed in coop move it closer to the stove or other source of heat. Do not ve the coop close to the stove for any length of time, as it may ıse the feathers to dry too thickly, in which case they are apt to rl instead of drying smooth and straight. Should the bird, on ning from the bath, appear to be too warm, move the coop farther ɔm the stove. The birds after being washed should be kept in this ɔm at a temperature of about 70° F. for at least 12 hours before ing shipped.

The final preparation.—When the fowl is thoroughly dry, examine shanks and feet closely to make sure that no dirt remains under

FIG. 7.—This club member is giving her birds a final inspection before sending them to the show.

around the scales on the legs. Such particles of dirt as do remain ay easily be removed with a toothpick. It is well at this time also moisten a small cloth with a little sweet oil or olive oil or vaseline nd rub it on the shanks, wattles, ear lobes, face, and comb. This ill help considerably to bring out the true color of these parts. Do ot apply too much oil or vaseline to the head or shanks, as it may oil the plumage.

SHIPPING THE FOWLS.

Under no circumstances should a bird be sent to an exhibit or how in a poorly constructed shipping coop. Many desirable and ikely fowls have been rendered unfit for show by shipping them in a oop that was either too small or poorly constructed. Coops for the purpose can either be purchased for a reasonable amount or b constructed by following the plans given in Farmers' Bulletin 110

When a slat-topped shipping coop is used, such as is shown i figure 3, Farmers' Bulletin 1107, tack a piece of muslin on the insid of the top so as to keep out the dirt and, in winter, to keep out th cold. Do not use a cloth that is so heavy and thick that it will cu off the ventilation.

Place a small amount of clean hay, or preferably clean stra or shavings free from dust, in the bottom of the coop. A cup o can for feed can be fastened securely in one of the corners of th coop about halfway between the top and the bottom. Feed is un necessary in the coop if the birds are shipped only a short distanc or if they are not to be in the coop for more than a day. When fee is provided such grain as whole corn or wheat is most satisfactory Water placed in the coop is likely to be spilled out and to soil th plumage. A satisfactory substitute can be obtained by tying mangel beet in one of the corners of the coop, that the fowls ma pick it and secure moisture enough to satisfy their thrist.

A tag or card plainly marked with the address to which the coo is shipped, together with a return address, should be tacked o pasted on the outside where it can be plainly seen.

The coop should be closed securely so that it will not come ope while being handled in transit. Provision, however, should be mad for the coop to be opened readily on arrival at the showroom. Unde no circumstances should a coop be so securely fastened that it wil have to be broken in order to remove the bird. When that is th case the coop is often rendered unfit for returning the fowl.

ATTENDING THE SHOW.

Whenever possible, club members should make it a point to atten poultry shows or fairs, especially when their birds are being exhibited. Such a trip will not only be full of interest, but will likewise enable members to see their own birds on display and also thos belonging to other members, which are competing with theirs fo a prize. Furthermore, such a trip will afford each member an opportunity to compare his birds with those being shown by adul poultrymen; and, again, members often become acquainted with suc poultrymen at these shows and get valuable information as to th breeding and mating of their birds.

FARMERS' BULLETINS SPECIALLY USEFUL FOR MEMBERS OF BOYS' AND GIRLS' POULTRY CLUBS.

1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1110. Lice, Mites, and Cleanliness.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1116. The Selection and Care of Poultry Breeding Stock.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.
585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
656. The Community Egg Circle.
682. A Simple Trap Nest for Poultry.
684. Squab Raising.
697. Duck Raising.
767. Goose Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. The American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-Yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continental Classes.
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and French Classes.
1067. Feeding Hens for Egg Production.

Bureau of Chemistry Circular 61, revised, How to Kill and Bleed Market Poultry.

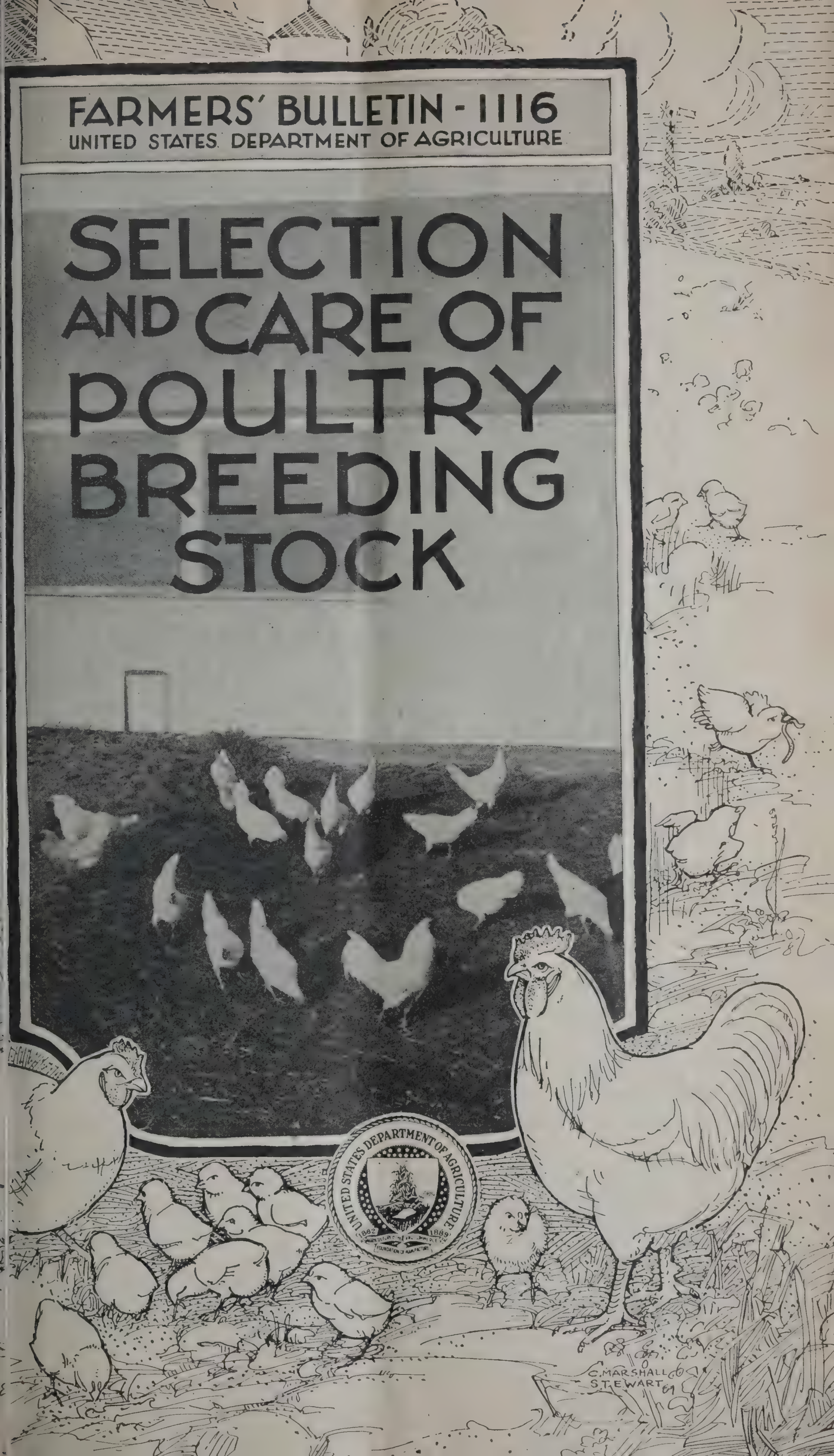
For copies of these bulletins or further information on poultry raising, write to your poultry-club leader, or to the Animal Husbandry Division, Bureau of Animal Industry,

UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

FARMERS' BULLETIN - 1116
UNITED STATES DEPARTMENT OF AGRICULTURE

SELECTION AND CARE OF POULTRY BREEDING STOCK



THIS BULLETIN has been written briefly and in simple terms for the beginner, and especially for members of the Boys' and Girls' Poultry Clubs. It gives information that should lead to the production of an ample supply of good eggs for hatching.

Contribution from the Bureau of Animal Industry
JOHN R. MOHLER, Chief
Washington, D. C. August, 1920

THE SELECTION AND CARE OF POULTRY BREEDING STOCK.

Rob R. Slocum,
Animal Husbandry Division.

CONTENTS.

	Page.		Page.
ep standardbred stock	3	Age of breeding stock	7
alth and vigor	3	Free range for the breeding pen	8
ject of breeding	4	Maintaining flock fertility	8
ne of mating	6	Housing breeding stock	9
e of matings	6	Feeding breeding stock	9

KEEP STANDARDBRED STOCK.

NE of the essentials for success in poultry-club work is good stock. This means standardbred stock;[1] for this stock has een bred and developed for specific purposes and therefore best eets the needs of the boy or girl. A flock of standardbred fowls ossesses a uniformity of appearance which the mongrel flock never as, and will arouse the club member's pride and lead to better care.

Moreover, standardbred fowls produce eggs and table carcasses hich are much more nearly uniform in size, shape, and color, and hich therefore bring better prices. It costs no more to feed and re for standardbred fowls than for mongrels, and there is often an dded income possible from them, which may amount to a handme profit from the sale of breeding stock or eggs for hatching.

HEALTH AND VIGOR.

Only by continuous selection for health and vigor is it possible to ild up a flock which will produce fertile eggs, strong chicks capable making quick growth, and pullets with sufficient stamina to ithstand the strain of heavy egg production. The appearance of bird is not always a sure indication of its vigor, but appearance d action taken together are a fairly reliable guide for picking out igorous birds.

The comb, face, and wattles should have a good, bright color; the es should be bright and fairly prominent, and the head should be omparatively broad and short, having a fairly short, well-curved eak and showing no tendency to be long, "snaky," or "crow-

---

Standard varieties of chickens are described and illustrated in Farmers' Bulletins 806 (the American ss), 898 (the Mediterranean and Continental classes), and 1052 (the Asiatic, English, and French classes).

headed." The bird should be alert and have a strong, vigoro carriage; the legs should be set well apart and strongly support t body, giving no indication of weakness or a knock-kneed conditi (see fig. 1). The bone, as seen in the shank, should be strong a not too fine for the breed, while the toes should be strong, straigh and not too long. The plumage should be clean and smooth, as lack of condition often accompanies soiled, roughened plumag

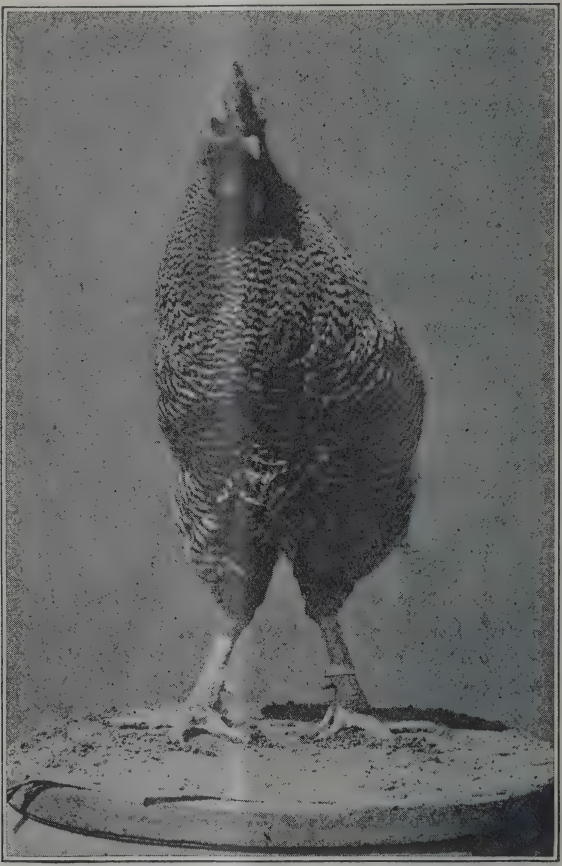


FIG. 1.—A knock-kneed male bird—an undesirable breeder.

The condition of flesh should be good, as a very thin bird is usual in poor health. Sick fowls or fowls which have apparently recover from sickness should never be used by the club members for breedi if it can be avoided.

OBJECT OF BREEDING.

In selecting stock for mating, the club member must keep clear in mind the purpose of the breeding. If it is the purpose to produ exhibition stock, it is necessary to select birds that are nearest t

ndard in color, type, and markings, or which when mated will
mbine their qualities so as to produce offspring most nearly con-
ming to the standard.

If the desire is to produce table fowls, a breed that has a standard
pe, or a body shape suitable for carrying an abundance of meat
ould be selected. They should be broad and deep of body, have
od length of back and keel, and especially a broad breast well
vered with meat. If the desire is to breed for eggs, birds should
chosen, so far as possible, that are good egg producers or are the
spring of good egg producers and conform to the standard require-
nts for the breed. If hens are trapnested, it is easy to make the

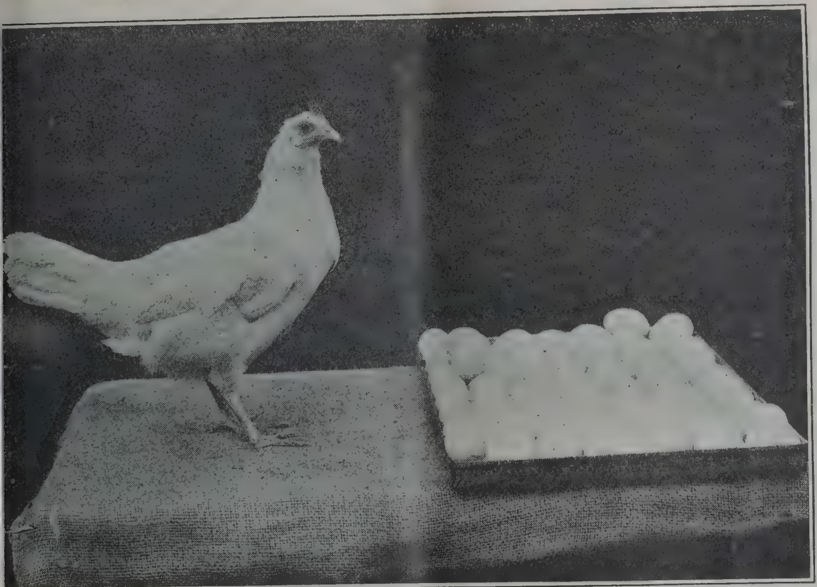


FIG. 2.—A poor producer, having laid but 80 eggs in a year.

lection on the basis of good egg production. If trap nests are
t used, it will be necessary to make observations of the stock
veral times during the fall, from August to November, in order to
te which are the best layers as indicated by the time of molt and
teness of laying. For information how to make such a selection,
e Farmers' Bulletin 1112.

Whatever the purpose of the breeding, progress will be made most
ickly by picking out the best individuals in the flock and using
em as breeders rather than by breeding from the flock as a whole.
he selection of a male for the mating will be influenced largely by
e character of the females used. If there is a general weakness in
e females in any respect, this should be offset so far as possible by
rength in that particular in the male used.

TIME OF MATING.

Matings should be made at least 2 weeks before beginning to save the eggs for hatching. If less time is allowed, the maximum fertility is not likely to be obtained. It is often desirable to mate even further ahead than 2 weeks so that a few eggs can be incubated for 5 or 6 days to see whether they are fertile. If these eggs are not fertile, there is still time to change the male bird and thus be sure of fertile eggs for the earlier hatches.

SIZE OF MATINGS.

The breed influences the size of the matings. If the fowls are confined to a yard it is usually desirable to run from 12 to 15 females of the smaller breeds, such as the Leghorn; from 10 to 12 females of the general-purpose breeds, such as the Plymouth Rock; and from 8 to 10 females of the heaviest breeds, such as the Brahma, with 1 male. Where the fowls have free range and the male is strong and vigorous, it is often possible to obtain fertile eggs with a considerably larger number of females to each male. A vigorous Plymouth Rock cockerel on free range should give good fertility when mated to 20 females, while a Leghorn male under similar conditions can be mated to 25 or 30 females, with good results. If eggs for hatching are desired from a flock too large for a single male to fertilize, two or more males can be run with it, either at the same time or preferably by alter-

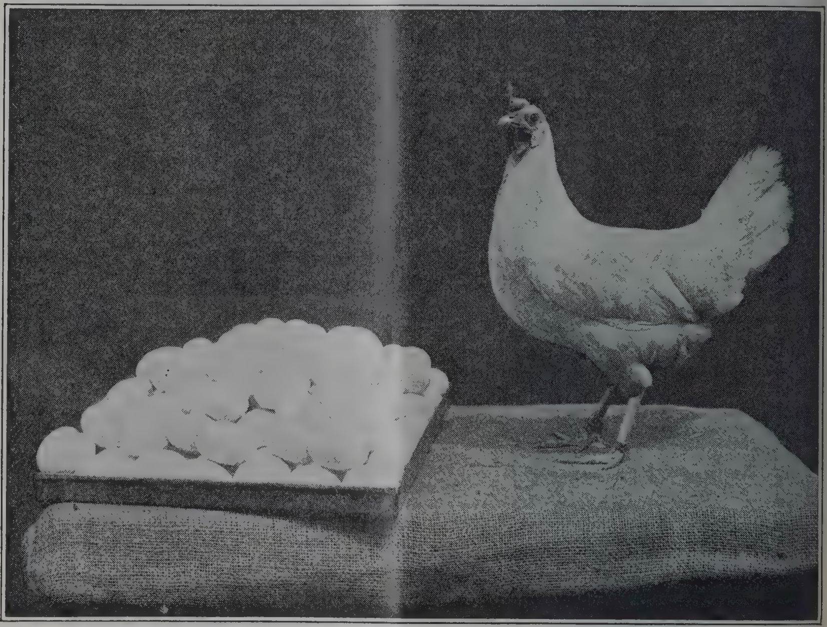
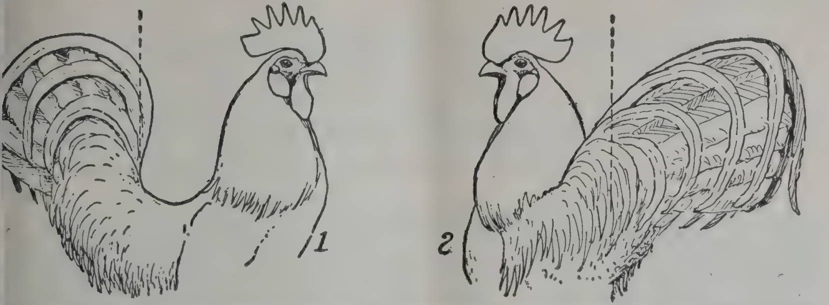


FIG. 3.—A good producer, having laid 160 eggs in a year.

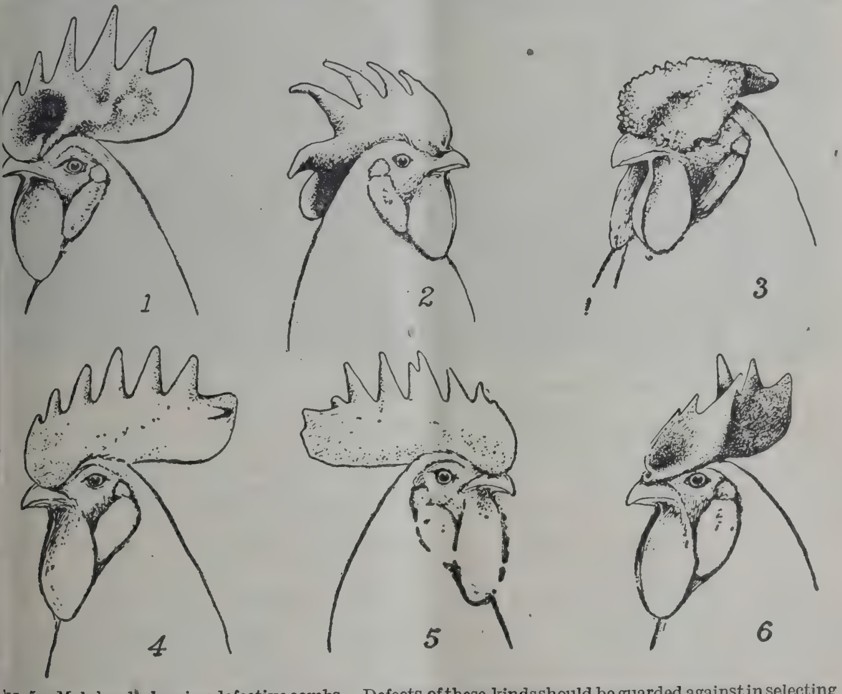
ing the males on successive days. It is best, however, to use a ating small enough so that a single male can be used.



G. 4.—Males with defective tail carriage. Such defects should be guarded against in selecting breeders. 1, Tail carried too high; 2, tail carried to one side, called "wry tail."

AGE OF BREEDING STOCK.

Either pullets or hens and either cockerels or cocks can be used in he breeding flock. If cockerels or pullets are used, they must be well atured. Hens are better than pullets, as they lay larger eggs and give better fertility and stronger chicks. Yearling and 2-year-old hens are better than older hens. If pullets are used as breeders hey should be mated with a cock rather than with a cockerel, while



IG. 5.—Male heads showing defective combs. Defects of these kinds should be guarded against in selecting breeders. 1, Thumb mark; 2, blade of comb following neck too closely and points showing tendency to lop; 3, rose comb showing hollow center; 4, side sprig; 5, uneven serrations and double point; 6, twisted comb.

if a cockerel is used he should be mated with hens rather than wit pullets. As a rule, well-matured cockerels will give better fertilit than cocks.

FREE RANGE FOR THE BREEDING PEN.

When possible, free range should be provided for the breeding stoc It is better to provide it during the entire fall and winter before th breeding season, but, if this is not possible, free range just precedin and during the breeding season will be of great value. Birds on fre range will get more exercise and therefore will be in better health an will give higher fertility, better hatches, and stronger chicks.

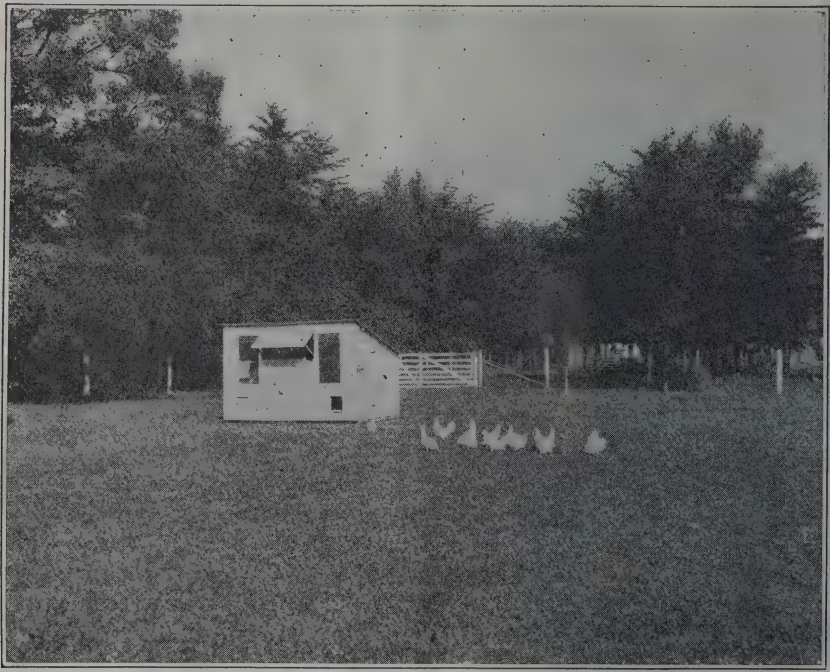


FIG. 6.—If possible the breeding pen should have free range.

MAINTAINING FLOCK FERTILITY.

Watch the breeding flock carefully and see that the fowls keep i good breeding condition. The birds and the houses should be examined to see that they are not infested with lice or mites. Either o these pests in any numbers will seriously affect or totally destro fertility. Care must also be exercised to see that the male does no frost his comb or wattles. If these are frosted his ability to fertiliz eggs will be impaired and may not be recovered for several weeks On very cold nights when there is danger of the combs being froste he males to be used as breeders must be placed where their combs ill not freeze. This can be done by placing them in a box or a rate of suitable size partly covered by a bag or cloth. The breeding ale should be examined occasionally after feeding to see that his rop is full and that he is not growing thin. Some males will allow he hens to eat all the feed, with the result that they get out of condition. If this happens the male must be fed separately from the ens at least once a day.

HOUSING BREEDING STOCK.

The breeding stock must be provided with comfortable quarters. his means that the house must be draft proof yet well ventilated nd dry. Room enough must be allowed so that the birds will not e crowded. If the birds are yarded, 4 square feet of floor space per ird should be allowed, but on free range from 3 to 3½ square feet er bird will be enough.

FEEDING BREEDING STOCK.

The breeders must be fed so as to keep them in good condition and o that they will produce eggs. Any good laying ration is suitable or this purpose, but it should not be extremely forcing, or, in other ords, should not have an extremely large proportion of beef scrap, ot more than from 10 to 15 per cent of the total ration. The birds hould be kept in good flesh but should not be allowed to become xcessively fat. All whole or cracked grain should be fed in the itter so as to force the fowls to exercise by scratching for it. As a upply of green feed is usually lacking late in the winter or early n the spring, sprouted oats, cabbage, mangels, or cut clover or alfalfa hould be fed to the fowls.

FARMERS' BULLETINS SPECIALLY USEFUL FOR MEMBERS OF BOYS' AND GILRS' POULTRY CLUBS.

1105. Care of Mature Fowls.
1106. Incubation of Hens' Eggs.
1107. Brood Coops and Appliances.
1108. Care of Baby Chicks.
1109. Preserving Eggs.
1111. Management of Growing Chicks.
1112. Culling for Eggs and Market.
1113. Poultry Houses.
1114. Common Poultry Diseases.
1115. Selection and Preparation of Fowls for Exhibition.

OTHER FARMERS' BULLETINS ON POULTRY RAISING.

287. Poultry Management.
528. Hints to Poultry Raisers.
574. Poultry House Construction.

585. Natural and Artificial Incubation of Hens' Eggs.
624. Natural and Artificial Brooding of Chickens.
682. A Simple Trap Nest for Poultry.
656. The Community Egg Circle.
684. Squab Raising.
697. Duck Raising.
767. Goose Raising.
791. Turkey Raising.
801. Mites and Lice on Poultry.
806. Standard Varieties of Chickens: I. The American Class.
830. Shipping Eggs by Parcel Post.
849. Capons and Caponizing.
858. The Guinea Fowl.
889. Back-Yard Poultry Keeping.
898. Standard Varieties of Chickens: II. The Mediterranean and Continental Classe
957. Important Poultry Diseases.
1040. Illustrated Poultry Primer.
1052. Standard Varieties of Chickens: III. The Asiatic, English, and French Classe
1067. Feeding Hens for Egg Production.

Bureau of Chemistry Circular 61, revised, How to Kill and Bleed Market Poultry.

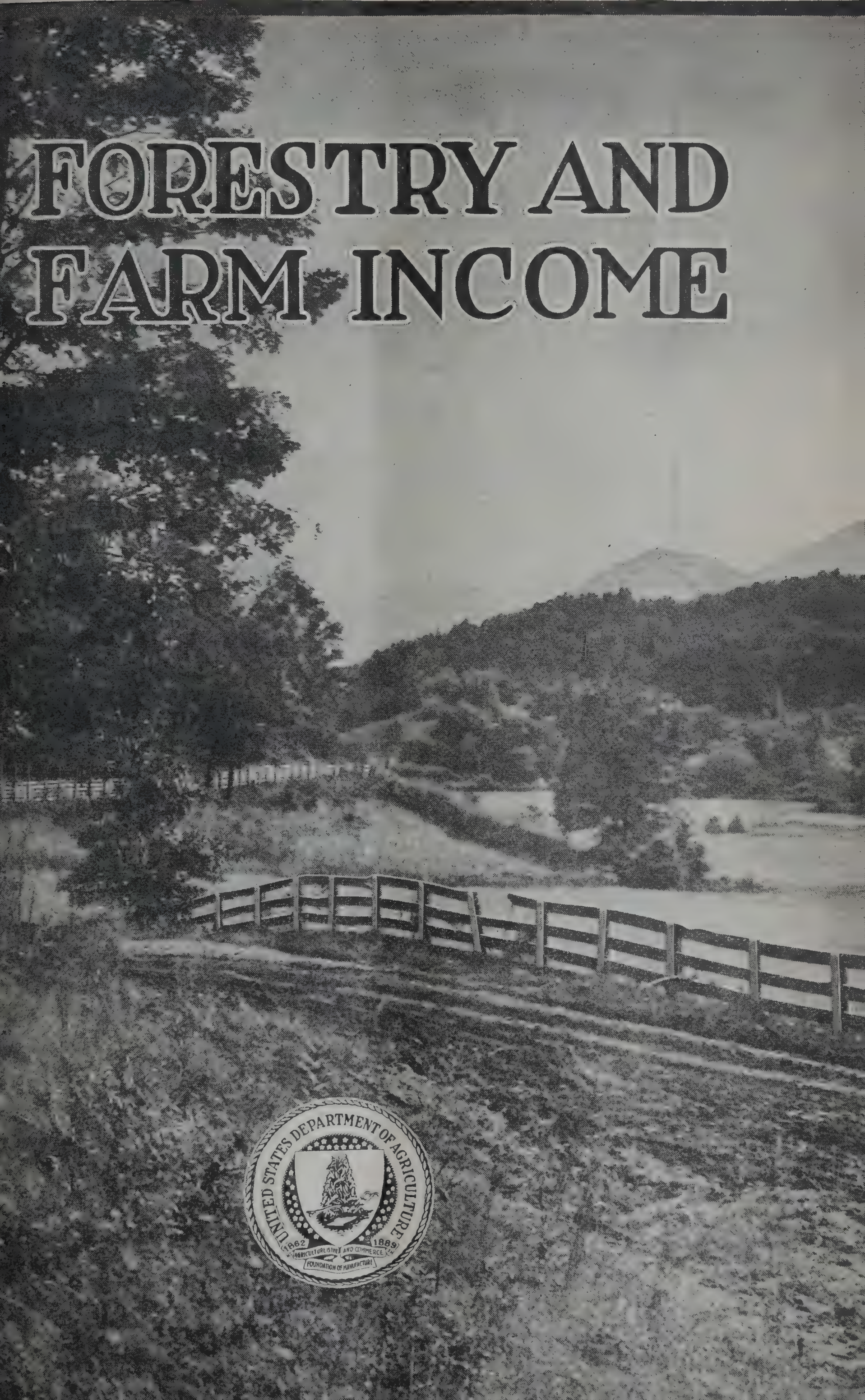
For copies of these bulletins or further information on poultry raising, write to yo poultry-club leader, or to the Animal Husbandry Division, Bureau of Animal Industr United States Department of Agriculture, Washington, D. C.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1

Farmers' Bulletin 1117

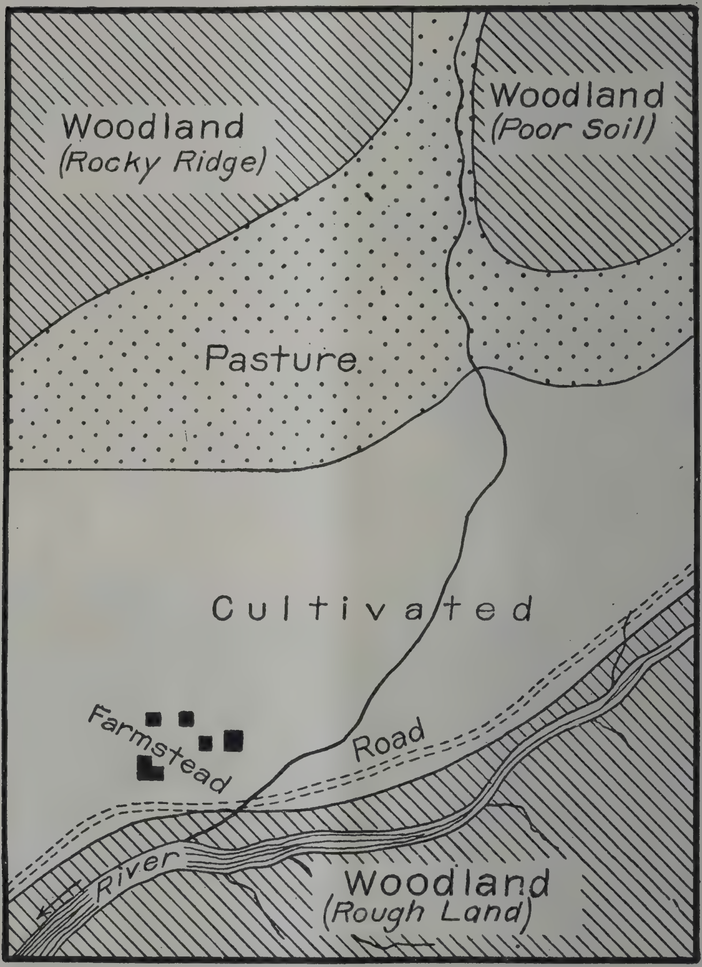
United States Department of Agriculture

FORESTRY AND FARM INCOME



1862 1889

NO IDLE LAND ON THE FARM.



Woodland on the hills, pasture land on the slopes, and cultivated land below.

Contribution from the Forest Service
WILLIAM B. GREELEY, Forester
Washington, D. C. August, 1920

FORESTRY AND FARM INCOME.

WILBUR R. MATTOON,
Extension Specialist in Forestry.

CONTENTS.

	Page.		Page.
farm forestry pays	3	Fire protection	21
nt of farm woodlands	4	Grazing and insect damage	21
e of woodland products	6	Using timber at home	23
ring good forest growth	7	Planting forest trees	27
roving the woods by cutting	11	Additional information	31
mating and selling timber	13		

WHY FARM FORESTRY PAYS.

HE right handling of forest trees on the farm will make it more prosperous, add to its comforts as a home, and enhance its value an investment.

The home forest, in many sections of the country, will supply the ber which the farm needs for buildings, fences, fuel, repairs of all ds, and many other uses; and there will often be a surplus which be sold in the form of standing timber, saw logs, posts, poles, ssties, pulpwood, fuelwood, and blocks or billets for making kes, handles, spools, boxes, barrels, and excelsior.

A well-cared-for home forest serves also as a windbreak for ildings, a shelter for live stock, a protection of valuable lands m erosion, a means of profitable employment for men and teams ring otherwise spare or idle time, a place of recreation, and an im- vement in the appearance of the farm.

Trees improve and build up the soil. The leaves, small twigs, and ner tree litter decompose and form a layer of dark-colored vege- le mold, which enriches the soil and stores up soil moisture. By ans of this layer of mold, the binding of the soil by the roots of e trees, and the resistance of the trunks to the rapid flow of water, e woods prevent floods from gullying or destroying the land by sion, particularly on steep slopes.

Even if a farmer sells no timber the woodland pays. The fire- od, fence posts, and material for repair and construction on the rm, the time and money saved by having them conveniently on nd, and the protection against extremes of weather afforded the ops, farm buildings, and stock are worth considerably more than e slight trouble and expense of raising and caring for the trees.

The woods need not occupy good farm land that will grow oth crops. Trees should, as a rule, be located on land too poor to cult vate, such as gullied or very rocky land, swamps, steep slopes, ar barren soils. Unused corners and small uncultivated spots abo the farm are good places for rapid-growing, useful trees. The chi economic reason for timber growing on the farm is to get a profit fro those portions which would otherwise be unproductive.

Though the land on which the farm forest is situated may not suitable for other crops, it should not be treated as waste lan (Fig. 1.) By a little care it can be made to produce valuable timbe Only a little attention is required, and this may be given in the wint or when other farm work is slack. Forest trees and woodland a more valuable now than they were a few years ago. Many trees th used to have little value, and even small trees that used to be count as brush to be got rid of, are now in good demand.

F-23266

FIG. 1.—Timber for the farm and for market, and shelter for the farmstead fro woodland covering a stony ridge.

A permanent woodland is an essential part of a well-equipp farm; and more than ever before farm woodland has become a val able asset convertible into money.

EXTENT OF FARM WOODLANDS.

About one-third of all the forest land of the United States is farms. According to the latest available figures (1910 census) th means that the farm woodlands amounted in all to about 190,000,0 acres. In the eastern United States—east of the Plains—the tot woodlands on farms amounted to about 178,000,000 acres. (Fig. 2

his is equivalent, roughly, to the aggregate area of the States of ennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, and ennessee. If placed continguous it would form a solid strip 105 iles in width reaching from New York to San Francisco. Farm oodlands in the eastern United States comprise an area nearly eight mes as large as the entire forest lands of France, which furnished

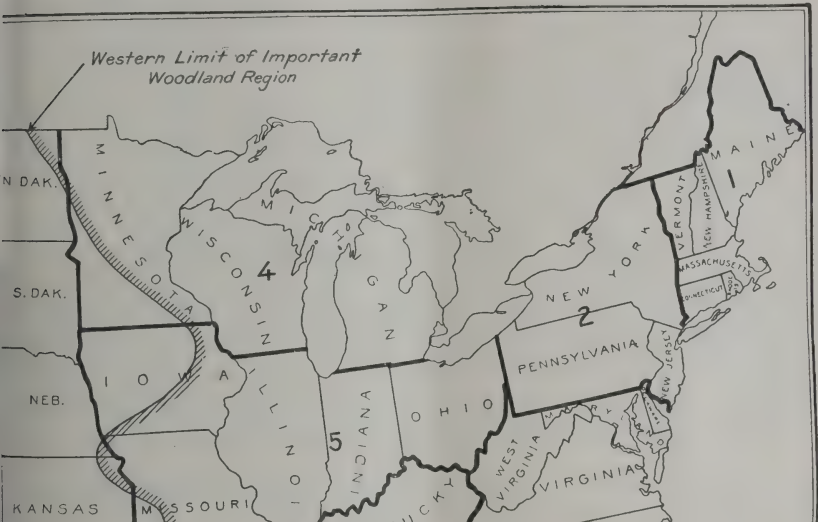


FIG. 2.—Important farm woodland regions.

ɔractically all the timber required during the war by the armies of France, Great Britain, Belgium, and the United States.

Assuming that every farm in the eastern United States has some woodland, there is an average of about 32 acres per farm. The amount of woodland on farms varies somewhat, however, in the different sections of the country. That portion of the United States under consideration is shown with its subdivisions in figure 2. T average area of woodland per farm and the average proportion of t farm that is wooded in the eastern half of the United States[1] a shown in the following table:

Group of States.	Average area of woodland per farm.	Proportion of farm land wooded.	Total are of farm woodlan
	Acres.	*Per cent.*	*Acres.*
New England (6)	41.6	39.8	7,852,
Middle Atlantic (3)	19.8	21.6	9,255,
South Atlantic (8)	43.8	46.9	21,037,
Lake (3)	22.6	18.1	12,227,
North Central (5)	17.0	14.4	47,902,
South Central (8)	38.4	30.5	76,343,
Average per farm	31.6	27.7	174,618,

VALUE OF WOODLAND PRODUCTS.

Considerable income may be derived from the home forest. T total value of forest products taken from timbered land on far east of the Great Plains, reported in the 1910 census, was $19 306,000.[2] More than half of this represents the value of wood a various minor wood products used on the farm and the rest t

TIMBER RAISING IN EASTERN UNITED STATES PAYS BECAUSE—

1. There is plenty of cheap land unfit for agriculture.
2. The abundant rainfall permits rapid tree growth.
3. Transportation facilities by rail and water are good.
4. Numerous large cities furnish an adequate market.
5. The region is far removed from the virgin supplies of the Pacific Northwest.

---

[1] Includes 33 eastern States, as far west as and including the tier of States fr Minnesota south to Louisiana, and Oklahoma and Texas.

[2] On account of big increases in value and probably some increase in production, t total value of the material cut from farm woodlands in 1919 is estimated at ab double, or about $400,000,000.

lue of the products sold or cut and held for sale. For the farms porting this amounts to an average of about $85 per farm. irty-five States reported over $1,000,000 each in forest products om their farms; and three—North Carolina, New York, and Vir- nia—reported more than $10,000,000 each.[1]

Firewood is one of the important crops of the farm. In 1918 average of 11.5 cords of wood, or a total of 77,092,000 cords, re burned on the farms of the country. The total production of rdwood during the year, which includes wood burned on farms d that sold by farmers to city dwellers, amounted to approxi- ately 102,903,000 cords. The average farm value in 1918 was .73 a cord. The figures show that farmers in the southern States e the heaviest fuel-wood users. North Carolina leads with an erage of 18 cords used on each farm during the year. The farms South Carolina and Arkansas averaged 17 cords; of Mississippi, cords; of Georgia, Tennessee, Louisiana, Kentucky, Nevada, and ermont, 15 cords. The value of the fuel-wood crop cut from farms 1918 was exceeded by that of only five crops—corns, wheat, oats, e, and cotton.

SECURING GOOD FOREST GROWTH.

At present farm woodlands are yielding, as a rule, only from one- ird to one-half the wood they could grow. This is because only few farmers realize the possibilities in their woodlands and give em proper care. As a result the home forest, which is close at

$1 A DAY PROFIT.

A NEW YORK FARMER'S WOODLAND OF 115 ACRES EARNS HIM A CONTINUOUS PROFIT OF $1 A DAY.

The annual growth is 0.65 cord per acre.
115×0.65=75 cords (mostly poplar).
He cuts an annual crop of 75 cords.
His profit is $4.86 per cord.
75×$4.86=$364.50.

---

[1] More than three-quarters of the present total timber supply of the United States is n privately owned lands. Much has been said about the National Forests, but the fact that they contain somewhat less than one-quarter of the country's timber, and the mber now being cut from them represents only about 3 per cent of the entire con- mption. The rest comes from private lands.

hand, where a little attention each year in protecting, cutting, an utilizing the timber would be very profitable, is in poor conditio

The amount of timber that an acre can grow in a year varies good deal with the quality of the soil and moisture supply and th kind and number of the trees per acre. If fully stocked with tree and well cared for, an acre of hardwoods should grow yearly fro about one-half to 1 cord of wood and of pine from 1 to 2 cord a cord being equivalent to about 500 board feet of saw timbe Growth averages rather less in the northern part of the countr because of the shorter season and somewhat more in the warm southern part.

The chief essentials in keeping the trees growing are excludin fires and allowing the humus to collect on the forest floor. Larg openings in the woods reduce the annual yield of timber and shou not be allowed to occur. The length of time required to reach me chantable size varies with the kind of tree and the use to which i wood is to be put. Posts and crossties may be grown in from 10 30 years, and most kinds of quick-growing trees will be large enoug for saw timber in from 20 to 40 years.

After logging, a new stand of young trees generally starts natu ally from seeds or sprouts from stumps. The natural seeding pro ess in the woods can be helped by harrowing the ground or, before t seed falls, turning hogs into the woodland, both of which enable t seed to get in contact with the mineral soil, or by conducting loggi operations in a good seed year before the seed falls, so that it germ nates quickly.

A WHITE PINE STAND IN NEW HAMPSHIRE GROWS 1,000 BOARD FEET A YEAR.

Two acres of white pine, near Keene, N. H., were sold three or four years ago, before the war prices, for $2,000 on the stump. The total stand was 254 cords, which equals 170,000 board feet, or an average of 85,000 feet per acre. The trees were from 80 to 85 years old; so the growth on each acre was about 1,000 feet per annum and the gross returns about $12.20 per acre per annum.

Some points to be remembered about trees which sprout are: (1) he most thrifty sprouts come from clean, well-cut stumps felled uring the late fall, winter, or very early spring before the sap gins to flow; and (2) the top of the stump should be cut slanting, as to shed water. Trees which sprout successfully include such ardwoods as the oaks, hickories, chestnut, basswood, gums, cottonvood, and willows, and young short-leaf and pitch pines.

F-392[illegible] A

FIG. 3.—Thrifty woods, good crops, and a happy farmer.

Woodlands may also be restocked with young trees by sowing seed r planting out small seedlings grown in nursery beds or dug up n the woods. If trees are to be planted, it is well to select those ative to the region which grow most rapidly and produce the most useful kinds of wood.

TREES TO CUT FOR IMPROVING THE WOODS.

Trees which are well suited for firewood, and the removal of which will be an improvement to the remaining trees in the stand.

Trees which have been overtopped by others and have had their growth stunted.

Diseased trees, or trees seriously injured by insect attacks, or trees extremely liable to such injury; for example, chestnut in the region subject to blight or birch in the gipsy-moth area.

Badly fire-scarred trees.

Trees of the less valuable species, such as beech, birch, black oak, black jack oak, or black gum, crowding the more valuable sugar maple, white or shortleaf pines, yellow poplar, or white oak.

Crooked trees and large-crowned, short-boled trees which will not make good lumber and which are crowding or overtopping others.

Slow-growing trees crowding fast-growing species of equal value.

Sound dead trees, both standing and down.

IMPROVING THE WOODS BY CUTTING.

Cutting should be done so as to cause the least possible waste or amage to other living trees, particularly young trees. In felling ees, advantage should be taken of natural openings in the woods.

Good management should result in a home forest fully stocked ith sound, well-shaped trees of valuable and useful kinds that are rowing as fast as possible. This can be brought about largely by utting out the inferior kinds—the "weed" trees—for exactly the ame reason that weeds are hoed out of the cornfield. The good rees need the light, space, soil moisture, and plant food that would therwise be taken by the less valuable trees. Sometimes it becomes dvisable to fill openings or improve the quality of the woods by lanting seeds or seedlings of desirable kinds of trees.

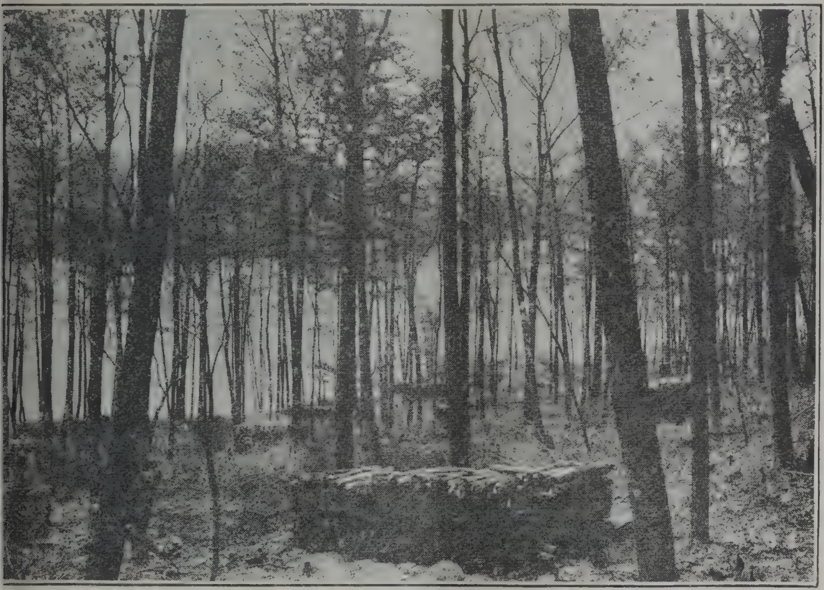


FIG. 4.—Woods improved by right cutting.

What sort of trees should be removed? Dead and dying trees; iseased trees; deformed trees which shade out better ones; the less aluable kinds, such as gray birch, aspen, blackjack oak, dogwood, ourwood, blue beech, ironwood, and others; and the less promising rees in crowded groups. By following this practice each year improvement in the forest is brought about in a relatively short time.

The wood removed in improvement cuttings need not be a loss. It should be considered as an early crop that can be used or sold, generally at a price to show a profit on the work of thinning, while the woods are made more valuable by its removal.[1]

---

[1] See Farmers' Bulletin 711, "The Care and Improvement of Farm Woods."

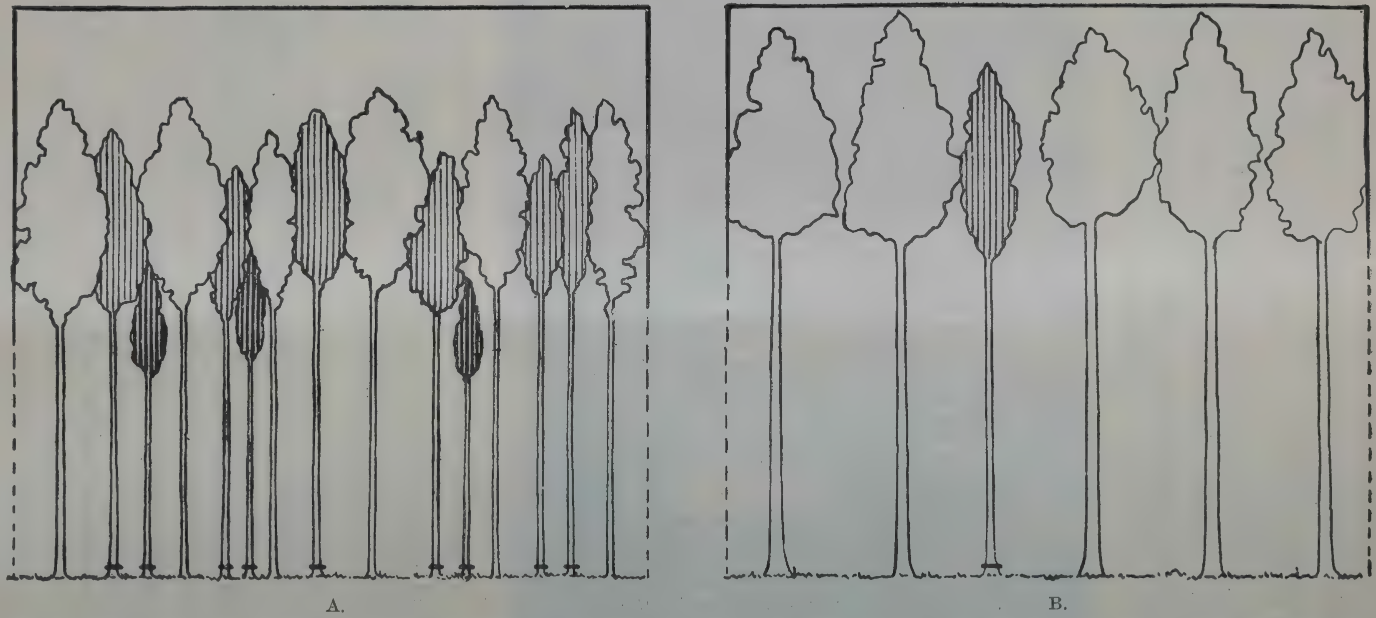


Fig. 6.—The growth and value of pine are increased by repeated thinning. The trees removed can generally be used or sold profitably for firewood, treated fence posts, or small timber. (A) Before thinning—15 overcrowded trees. (Shaded trees to be cut.) (B) The same stand 5 years later after thinning—6 larger and more valuable trees. (Shaded tree to be cut).

When timber is no longer growing at a profitable rate it should be ut and used or sold. A farmer who is ready to sell timber would rofit by measuring his trees, estimating how much saw timber or other products they contain, and making inquiry to find out how much they are worth. If he does not know or can not find out how to do this, he should employ some experienced and reliable person to estimate and value his timber for him.

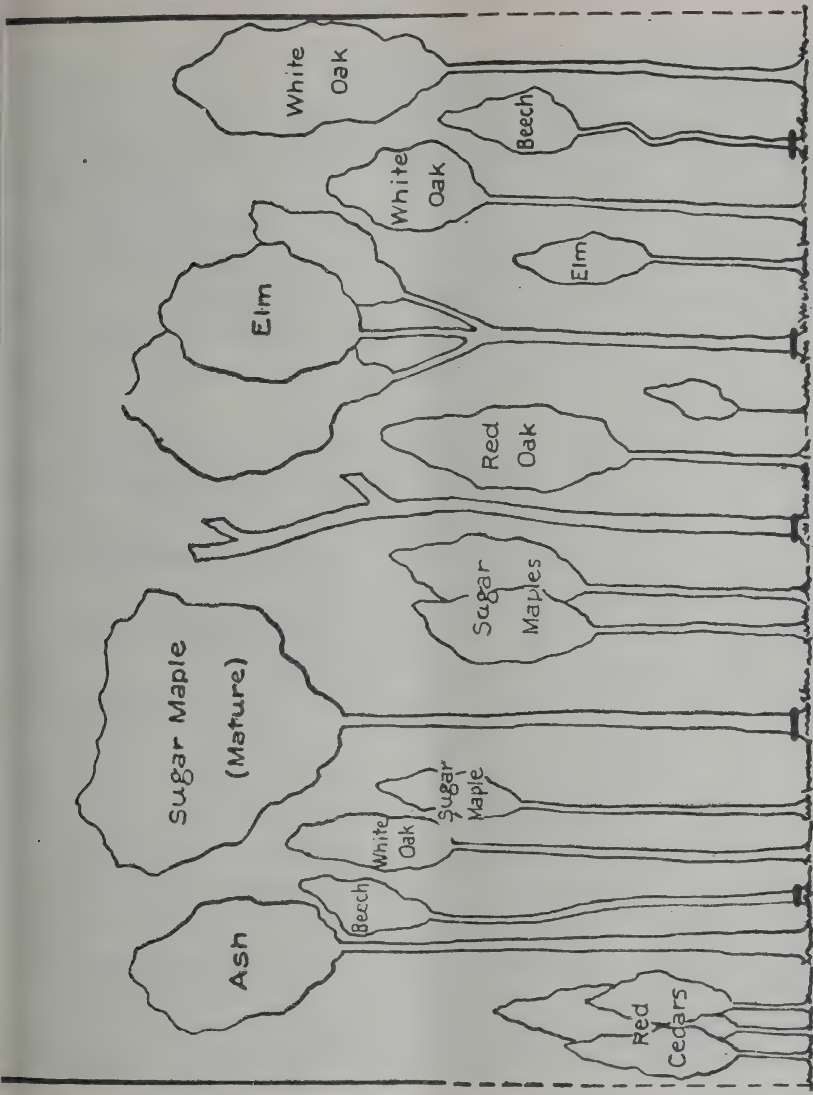


FIG. 5.—Improving hardwoods by thinning. Mature and defective trees and inferior species to be cut. A good stand left of thrifty middle-aged and promising young trees.

The customary units of measure in selling farm timber are board feet, cords, linear feet, and the piece. A board foot, for example, is 12 inches long, 12 inches wide, and 1 inch thick, or its equivalent.

TEN HELPS IN MARKETING WOODLAND PRODUCTS.

1. Get prices for various wood products from as many saw mills and other wood-using plants as possible.
2. Before selling, consult neighbors who have sold timber and benefit from their experiences.
3. Investigate local timber requirements and prices. Your products may be worth more locally because transportation is saved.
4. Advertise in papers and otherwise secure outside competition.
5. Secure bids if practicable both by the lump and by log-scale measure.
6. Be sure that you are selling to responsible purchasers.
7. Get a reliable estimate of the amount and value of the material before selling.
8. Market the higher grades of timber and use the cheaper for farm purposes.
9. Remember that standing timber can wait over a period of low prices without rapid deterioration.
10. Use a written agreement in selling timber, especially if cutting is done by purchaser.

he standard cord of wood is 4 feet high, 4 feet wide, and 8 feet long. he linear foot is a measure of length only, without regard to the her dimensions of the material. Piece measure is only a count the pieces in any form in which the wood is sold.

F-71093

FIG. 7.—Fast-growing hickory is one of the most marketable forest trees. It is in strong demand for spokes and implement handles.

Logs and standing trees are usually estimated in board feet. Saw timber is measured in board feet. Round timber, such as poles and piling, is usually sold by the linear foot. Firewood, pulpwood, and wood for distillation and other uses cut in short lengths are usually sold by the cord. Fence posts, ties, telephone poles, and some other forms of timber are sold by the piece.

FARM WOODLAND IN THE NORTH.

Farm woodlands amount to two-fifths of all forested lands.

There are about 53,000,000 acres of farm woodland.

In New England more than 65 per cent of all forested land is on farms, and in Ohio, Indiana, Illinois, and Iowa from 80 to 100 per cent.

The income to farms from timber products is estimated at about $162,000,000 yearly.

Saw timber in the standing tree is estimated by measuring the diameter of the tree, outside the bark, at breast height (4½ feet above the ground), and measuring or estimating the height of the tree. When these measurements are known the contents of the tree can be found from a volume table.[1] Often the length of the part of the trunk to be used is taken in units, or number of 16-foot logs, instead of the total height of the tree.

A volume table is one showing in board feet the amount of timber that can be sawed from trees of given heights and diameters or from a given number of merchantable logs and diameters. For example, a volume table for white oak would show that a tree 18 inches in diameter (measured outside the bark at breast height) and having three merchantable 16-foot logs will saw out 286 board feet of lumber Volume tables are made for different kinds of trees, each table based on the average of many measures of felled trees.

A saw log is measured by taking the length of the log and its diameter inside the bark at the small end, then employing a log rule to estimate the amount or number of board feet it contains. A log rule is a statement of the estimated number of board feet of lumber that can be sawed from logs of different lengths and sizes. A good rule for 12-foot logs is to multiply the diameter inside bark at the small end by half the diameter. For shorter logs the contents will be proportional to the length of the logs. Thus, a 12-foot log 16 inches in diameter will saw out about 16×8 or 128 board feet, while a 10-foot log 14 inches in diameter will cut $\frac{10}{12}$ of 14×7, or 81$\frac{2}{3}$

---

[1] For volume tables and other information on estimating and measuring timber, see Farmers' Bulletin 715 or apply to State foresters.

FARM WOODLAND IN THE SOUTH.

Woodlands on farms comprise one-half of all the forested lands.

There are more than 125,000,000 acres of farm woodland.

In Maryland, Virginia, North Carolina, Kentucky, and Oklahoma, more than 60 per cent of all forest land is on farms.

The present yearly farm income from woodlands is estimated at about $150,000,000.

board feet. The Doyle rule is probably most commonly used in this country. To determine the number of board feet in a log by this rule deduct 4 inches from the diameter of the small end, then square one-fourth the remainder and multiply the product by the length in feet. For example, a log measuring 20 inches at the small end and 12 feet long contains 192 feet. This is not an accurate rule for small-sized timber, since it shows one-half to one-fourth fewer board feet in logs from 6 to 20 inches in diameter than are actually sawed out in the mill. For logs larger than 20 inches it is fairly accurate. In buying and selling operations the value placed on small logs is sometimes made to take into account the small scale on the basis of the Doyle rule, but more often the seller is the loser.

FARM FORESTRY MAKES FARMING PAY BETTER BY—

1. Marketing timber profitably.
2. Supplying timber for farm needs.
3. Furnishing employment for men and teams in winter.
4. Making waste lands yield a profit.
5. Increasing the sale value of the farm.

For handy reference the Champlain and Doyle log scales are given (Tables 1 and 2) for logs measuring from 6 to 25 inches in diameter The former scale shows approximately the amount of lumber tha can be sawed out in small mills using circular saws, cutting ¼-inch saw kerf but operated carefully without unnecessary waste and otherwise closely utilizing the timber.

TABLE 1.—*Champlain Log Scale.*[1]

Diameter of log (between bark at small end).	Length of log, in feet.								
	8	9	10	11	12	13	14	15	16
	Contents of log, in board feet.								
Inches.									
6	11	12	14	15	17	18	19	21	
7	16	18	20	22	24	26	28	30	
8	21	24	27	30	32	35	38	40	
9	28	31	35	38	42	45	49	52	
10	35	40	44	48	53	57	62	66	
11	43	49	54	60	65	70	76	81	8
12	52	59	65	72	78	85	92	98	1
13	62	70	78	85	93	101	109	116	1
14	73	82	91	100	109	118	127	136	1
15	84	95	105	116	126	137	147	158	1
16	97	109	121	133	145	157	169	181	1
17	110	123	137	151	165	178	192	206	2
18	124	139	155	170	186	201	217	232	2
19	139	156	173	190	208	225	242	260	2
20	154	173	193	212	231	251	270	289	3
21	171	192	213	235	256	277	299	320	3
22	188	212	235	259	282	306	329	353	3
23	206	232	258	284	309	335	361	387	4
24	225	253	282	310	338	366	394	422	4
25	245	276	306	337	368	398	429	460	4

TABLE 2.—*Doyle Log Scale.*[2]

Diameter of log (between bark at small end).	Length of log, in feet.					
	6	8	10	12	14	16
	Contents of log, in board feet.					
Inches.						
6	1.5	2	2.5	3	3.5	
7	3.4	4.5	5.6	6.8	7.9	
8	6	8	10	12	14	
9	9	12	16	19	22	
10	13	18	22	27	31	
11	18	24	31	37	43	
12	24	32	40	48	56	
13	30	40	51	61	71	
14	37	50	62	75	87	1
15	45	60	76	91	106	1
16	54	72	90	108	126	1
17	63	84	106	127	148	1
18	73	98	122	147	171	1
19	84	112	141	169	197	2
20	96	128	160	192	224	2
21	108	144	181	217	253	2
22	121	162	202	243	283	3
23	135	180	226	271	316	3
24	150	200	250	300	350	4
25	165	220	276	331	386	4

---

[1] The Champlain rule shows approximately the amount of lumber cut from logs by close sawing. T full table includes logs up to 60 inches in diameter.

[2] The Doyle rule was originated at the time of abundant and cheap timber. It gives a much smaller sca for small-sized logs than is actually sawed out according to present custom. The full table runs to a includes logs 40 inches in diameter.

F-23309A

FIG. 8.—Choice logs bring high prices and are often shipped long distances.

In finding a buyer for his timber the owner should inquire of is neighbors who have sold, or at local sawmills, wood yards, woodsing factories, railroad stations, and telegraph and telephone companies. He should also advertise in the papers and write personal etters furnishing a brief description of the kind, quality, and mount of timber for sale, in order to awaken competition among ocal and outside buyers. Securing a number of bids for the same iece of timber will tend to develop the best market and increase eturns. It is well to have a written agreement as to the manner in which the timber shall be cut, the amount and form of payment.[1]

Some of the industries buy their supplies largely or wholly in the log; hence, in many cases it will pay the farmer to look up these special markets for his logs, bolts, poles, ties, etc. Industries buying their supplies more or less generally in the form of round timber are manufacturers of handles, cooperage, veneer, woodenware and novelties, shuttles, bobbins and spools, vehicle stock, athletic goods, and pulpwood. Poles are purchased by electric lighting, power, and telephone companies. Markets for piling will be found by applying to railroads, wharf, bridge, and bulkhead contractors in the larger towns and cities. For prices on ties, consult the nearest local railroad station agent. Cordwood is used by brickmakers, bakeries, limekiln operators, and fuel dealers in towns.

---

[1] A sample contract and a good many helpful points on measuring and selling farm forest products may be found in Farmers' Bulletin 715, "Measuring and Marketing Farm Timber," and Farmers' Bulletin 1100, "Cooperative Marketing of Woodland Products."

PROTECT WOODS FROM FIRE.

A tree will make a million matches—a match may destroy a million trees.

Take no chances with lighted matches, tobacco, brush or camp fires.

Forest destruction is quick—forest growth slow.

Burned timber pays no wages.

When fire is discovered, put it out if you can. Get help if you need it.

ARE YOU PRACTICING PREVENTION AND FOREST PROTECTION?

HELP PREVENT WOODS FIRES.

BE SURE your match is out before throwing it away.

DON'T throw away burning tobacco.

CHOOSE a safe place and make your camp fire small.

PUT OUT your fire with water and then cover it with earth.

DON'T make large brush heaps. Choose a still day for burning, and plow furrows to protect near-by woods.

BE CAREFUL WITH FIRE.

FIRE PROTECTION.

The forest must be protected. Fire, grazing, careless logging, tree iseases, and insect pests are the principal sources of injury.

Fire kills the little trees and weakens full-grown trees so that they ay become diseased or infested with insects. It also destroys the umus cover of leaves and twigs that ordinarily protects the trees gainst summer drought and heat, conserves water for the springs nd streams, and enriches the soil by adding nitrogen. The loss of is natural fertilizer by burning amounts to a very large sum, ntirely sufficient to warrant complete fire protection of the country's orests.

Burning over the ground with the aim of improving grazing is an xpensive mistake. Although it is possible to secure green grass for tock a week or two earlier in the spring, most of the rich leguminous lants and annual grasses are exterminated, leaving as survivors nly the hardy bunch, wiry, and other coarse perennial grasses.

Dead trees and tops cut in logging are a fire menace and should, f possible, be utilized. Sawlogs or firewood can be made out of the ead trees and the unused large tops should be lopped so that they vill lie close to the ground and rot quickly.

Some idea of the prevalence of fires in the eastern United States, ncluding the Mississippi Basin, may be formed from the fact that ere occur 80 out of every 100 forest fires. For the three years of 916, 1917, and 1918 the 27,500 fires in this region burned over 3,000,000 acres of forest land and caused a property loss amounting o more than $19,000,000. While fires were reported from all States, greater number of fires and larger losses occurred in the southern ine district than in any other important forest region.

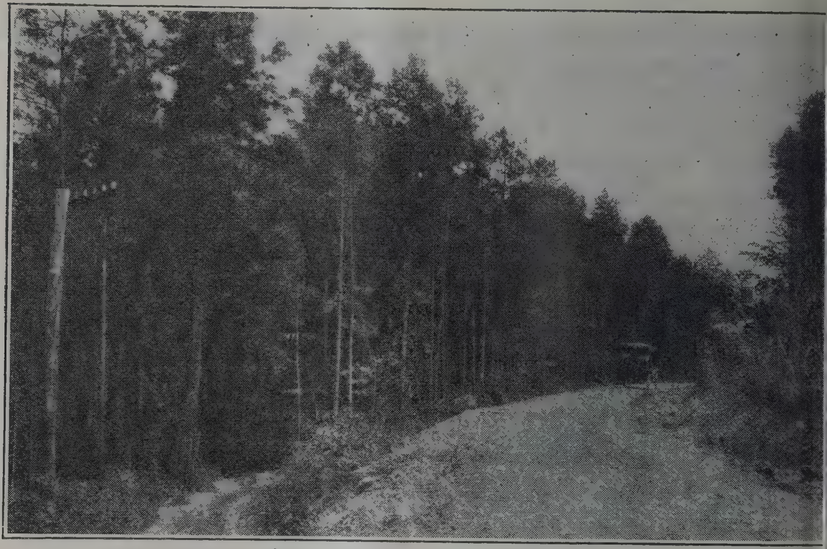
Are there any laws about forest fires? Yes. Practically every State has strict laws against the setting of fire and carelessness in he burning of brush. In a number of States the railroads are required to use efficient spark arresters in their locomotives and burn ire lines along their rights of way.

Forest fire protective systems have been established by a number of States. Patrolmen are employed who travel the regions where here is danger of forest fires, watch for fire, and educate the public n the need for care in preventing fire and for getting quickly to ny fire that may occur. Owners of woodland should get in touch vith the State foresters and fire patrolmen and secure their cooperaion and assistance in keeping down fire damage.

GRAZING AND INSECT DAMAGE.

Horses and cattle eat and break down young trees and pack the ground hard. Sheep and goats destroy large numbers of small trees by eating them. Hogs root up the ground, digging up th young trees and roots and sometimes eating the roots. They als prevent young trees from starting by devouring the nuts and othe seeds from which they grow. On the other hand, however, tree bearing small or unpalatable seeds often start well after hogs hav rooted up the leaf litter and soil.

Some people fear that good pasture will be wasted by keepin stock out of the woods. This is hardly true, since a fully stocke woodland has little or no grass in it, for the reason that there i insufficient light. (Fig. 9.) Studies in farm management in northwestern Pennsylvania show that an open stand of trees, such as occu in average wooded pastures, reduces the pasturage value of the lan as much as 65 to 70 per cent.[1] Grass in the woods is a sign that th stand is in poor condition and the trees too far apart for growin a good quality and large amount of timber. This hardly applies i the southern longleaf pine region, where much good timber occur in open stands. Grass grown under the shade of trees is much les nutritious than that grown in the open, so its actual food valu is small.



F-39252A

FIG. 9.—Pine grows rapidly and every five years yields a crop by thinning.

Plenty of shade for live stock should be provided in pastures, bu pasture land and woodland are most profitable when managed separately, each for the growing of its own individual product.

---

[1] Agriculture Bulletin 853, "The Organization and Management of Farms in Nort western Pennsylvania."

Woodland may be guarded against serious insect damage and isease by removing dead or dying trees and all those showing signs f insect attack or decay. In the South, pine should be cut in the ol part of the year. When it is cut in summer, barkbeetles and ood-borers injure the cut trees, multiply rapidly, and spread to ving trees, which they often kill by eating the rich inner bark for od. In cases of insect menace or injury it would be best to get to communication with the Bureau of Entomology, U. S. Department of Agriculture, or the State entomologist.

IG. 10.—Because they split easily, clear white oak butt logs have been worked up into fence posts when several farmers could have jointly shipped a carload at fancy prices.

USING TIMBER AT HOME.

Lack of knowledge of the proper use of timber is one form of arm mismanagement.

It is a mistake to saw up choice logs of white oak, ash, cherry, nd yellow poplar for rough uses at home, or to use clear black alnut for gate boards, or split up white-oak butts for fence posts. Fig. 10.) Many valuable logs go into crossties, when they would ring the owner much more if sold as saw logs. Large numbers f young, rapid-growing trees, producing only one small tie, are ut, which, if left to grow for from three to five years, would more han double the profit.

Cutting is commonly done promiscuously without regard to coninuing the future productiveness of the woodland, and large mounts of timber are commonly wasted in high stumps and long ops.

The importance of the home forest as a reserve for “pinch” times can not be overestimated. In the midst of the lumber shortage and high prices during the fall of 1919 and the spring of 1920, for example, communities and individual farms having local supplies of standing timber are reported to have suffered the least from the widespread deterioration of farm buildings and deferment of necessary new construction. The effect has been not only smaller losses of crops and live stock but better farm conditions and more contended farm labor.

Timber that is cut in the late spring and summer months should be handled with special care to avoid injury. This is because freshly cut wood is then more likely to be attacked by insects and fung than during the cold part of the year. Seasoning also proceeds more rapidly during the warmer season and may cause excessive checking If rightly handled, posts, poles, and logs may be cut at any season without their durability being affected. In no case should wood be allowed to lie in direct contact with the ground. The opportunity for insect attack and decay can be reduced to a minimum by peeling the timbers and open piling them off the ground in a shaded but dry place. This, however, does not retard checking of the wood

Logs are sometimes stored under water in the hot season to prevent blue stain, checking, insect attack, and decay. Painting the ends of logs with a yellow ochre or barn paint will very materially retard injury by end checking. Painting peeled timbers with creosote will prevent sap stain and decay.

TREATING FENCE POSTS.

Every farm needs fence posts, but relatively few have sufficient supplies of lasting wood to meet home needs. This is particularly tru in the Middle West and South. By means of a simple method o treating timber in open tanks with cold-tar creosote, the post and pol problem can be readily solved. By this process such short-lived woods as soft maple, beech, birch, sweet gum, black gum, young o sap pine, and red oak are made durable for use in the ground fo 10 to 20 years, or even longer.

A comparison of the annual costs of maintaining three fence built with posts of untreated sap pine, untreated white or post oak treated white or post oak, and treated sap pine, respectively, ind cates a saving of $6 to $24 per mile in favor of the treated pine The following estimate is believed to be representative of the cost over a considerable part of the region where white oak or post oa and yellow pine occur:

Relative economy of treated and untreated fence posts.[1]

	Untreated sap pine.	Untreated white or post oak.	Creosoted sap pine.
st of post	$0.05	$0.12	$0.07
st of treatment			.18
st of setting	.15	.15	.15
Total cost of post in ground	.20	.27	.40
verage life of post in years	2	6	15
verage yearly cost	$0.10	$0.04½	$0.02⅔
verage yearly cost of 1 mile of fence (posts 1 rod apart)	$32.00	$14.40	$8.00

[1] The costs of materials and labor, which were representive in 1919, should be regarded showing relative rather than absolute values.

Although more expensive at the outset, creosoted posts are gen- ally more economical to use than many kinds of untreated, short- ved woods, because of their much greater lasting qualities. The xceptions would be in remote localities with cheap wood and labor nd where it would be expensive to obtain creosote. The large ving in the replacement charges, which ordinarily mount up so igh in maintaining a fence, and the use of cheap and inferior inds of wood in the first place, much more than offset the increased ost of thorough treatment with creosote. (Fig. 11.) Treated posts re a good investment and their use where lasting woods are arce or expensive is a sign of sound judgment in farm management.

Cutting and seasoning.—It is important that the timber be peeled nd thoroughly seasoned before an attempt is made to treat it. Small akes of inner bark left on the wood prevent proper absorption of e preservative at those places. Peeling is done most easily during e spring months, but is carried on at other seasons of the year. he posts to be treated should be peeled from 3 to 4 months, de- ending upon the weather, before treatment, and open-piled in a dry tuation to effect proper seasoning.

Kinds of posts.—Because they have a uniform absorbing surface f sap wood, round sticks are more satisfactory than split timber or treatment.

It is not profitable to treat lasting woods, such as red cedar, black ocust, chestnut, and white oak. Practically all of the soft woods r sap woods may be treated and profitably used as posts.

Small-sized timber.—When treated timber is used it is not neces- ary to cut the large-sized line posts commonly employed untreated n the past. A post from 2 to 3 inches in top diameter, long enough o allow only a few inches above the top wire, costs less for creosot- ng and labor in handling, lasts as long as larger-sized timber, and ossesses ample strength for ordinary fences. Small-sized trees are abundant in second-growth timber, often being crowded out by mor vigorous neighboring trees. Cutting these for fence posts utilize

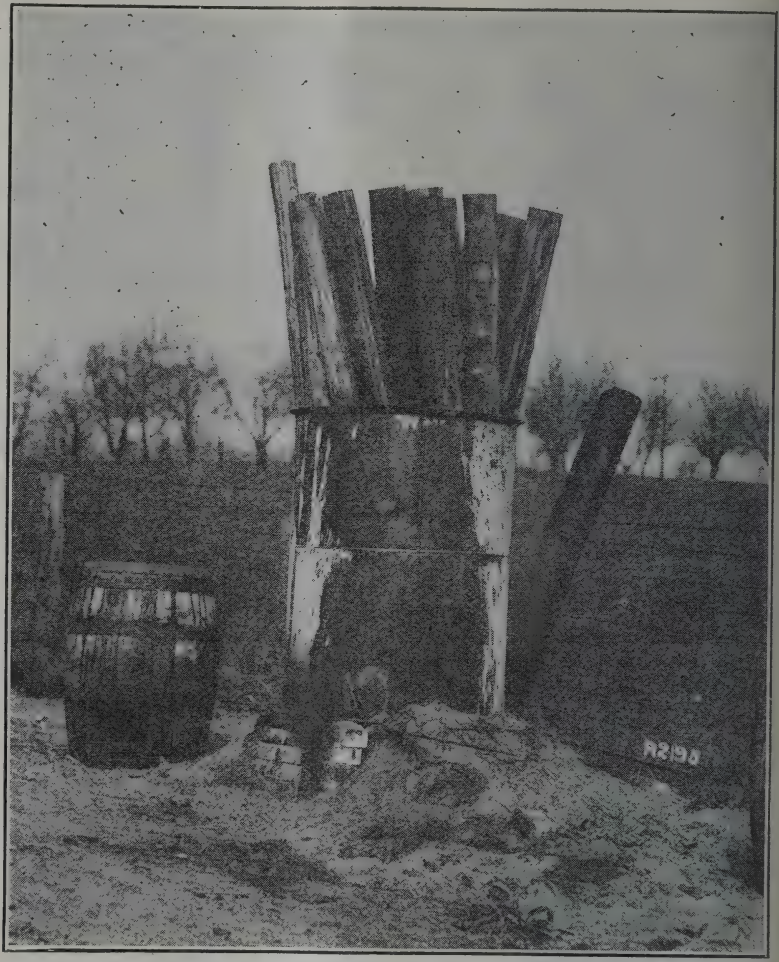


FIG. 11.—The treating of nondurable timber brings many kinds of wood into new forms of utilization. (Photo by courtesy of Iowa State College of Agriculture.)

the forest product that would often otherwise be wasted, improve the remaining stand, and furnishes profitable employment on th farm during slack time.

Kind of treatment.—Application of creosote by brushing over th whole post is only slightly effective in preventing decay, and ro often starts in small cracks which are not reached by the brush, o in checks which soon develop while the post is in use.

Open-tank treatment with a hot bath, followed by a cold bath i recommended for fence posts. The sapwood surrounding the heart ood takes treatment readily and is thereby protected against the trance of decay.

Preservative.—It is important to use a good preservative, and coal-r creosote has been found to be by far the most satisfactory mateal. Ordinary gas tar or coal tar has been used more or less, but is usually too thick even when treated to give a fair degree of netration.

Treating.—The best treatment is that which results in the deepest netration into the wood with the least absorption of creosote. he butts of the posts should be placed for one to two hours in creote heated to a temperature of 180° to 220° F. It is important to eat the wood to a height of a foot above the proposed ground line. the southern States, the entire post should then be submerged into ld oil, 80° to 100° F., for one to two hours, or for such time as is cessary to get a good penetration. In the North where decay is ss rapid, the cold treatment is applied usually to the butts only, the ps being treated by painting or dipping in creosote.

A satisfactory outfit for treating posts successfully consists of an right cylindrical tank for the hot treatment, and a horizontal ctangular tank for the cold bath.

A saving in cost can be made by two or more farmers joining tother in the purchase and use of treating tanks. This method in number of instances has proved to be a successful form of cooperaon.

PLANTING FOREST TREES.

The profitableness of forest planting can not be laid down by any le, since it is subject to very wide variation. Rapid-growing kinds trees of good, standard value can be grown profitably, however, cheap lands located relatively near good markets. For example, shown by actual demonstration on page 29, white pine yields very ood returns in New England, and the same may be said of the yelw pines in various parts of the South. By good authorities it is eld that white pine is the most profitable crop possible on large eas of New England. In the Northeastern States, Wisconsin, and innesota, the white pine blister rust is present, and planters of hite pine should protect it from this disease by destroying all wild nd cultivated currants and gooseberries within three hundred yards the plantation. These bushes are the alternate hosts of the blister ust and if permitted to remain near native or planted white pines in gions where the blister rust is prevalent, the trees become dissed and gradually die. Usually the cost of uprooting wild currant nd gooseberry bushes is small.[1]

In rich agricultural belts the planting of forest trees on a large ale for direct money returns would undoubtedly prove to be

---

[1] For further information relative to protection from blister rust consult your State rester or the Bureau of Plant Industry, United States Department of Agriculture.

DENUDED HILLS
MEAN—

Floods.
Clogging of streams, lakes, and reservoirs.
Waste of soil.
Destruction of prosperous farms and other industries.

DEVASTATION.

a losing investment. Here, however, considerable forest plantin
goes on, but on relatively small, isolated tracts on farms and fo
special purposes, depending upon local conditions. Forest trees ar
planted chiefly to check soil erosion on slopes; to afford a wind
break as shelter for growing crops, live stock, and man; and t
utilize to the best advantage rough, stony, or poor soils and inacces
sible and wet lands.

In western Tennessee, where the soil is a very deep, rich, clay loam
known locally as “brown loam,” forest planting is being extensivel
pushed by the State as a means of reclaiming and making profitabl
badly eroding lands and at the same time checking at the source o
the small streams the silting which results in expensive dredging op
erations on the Mississippi River and its navigable tributaries. Simi
lar conditions prevail over large areas in other States of the Missis
sippi Basin and in the Piedmont section and lower slopes of th
Appalachians.

On the farms of the eastern United States many thousands of acre
of slopes have been cleared and become waste from which the fores
should never have been removed. Careful cutting by the selectio
method would have resulted in keeping the land continuously pro
ductive. This mistake is still going on in some rural sections wher
foresight and study have not yet been generally applied to farn
management.

FORESTED HILLS

Protect the soil.
Store up water.
Feed springs and streams.
Support prosperous farms and other industries.

PROTECTION.

PROFIT IN GROWING TIMBER.

AN EXAMPLE.

This white pine, which was planted on an abandoned sidehill pasture of about 3 acres in New Hampshire 44 years ago, now contains about 90,000 board feet of lumber. The total outlay at the time, counting the value of the land and labor of planting, was $35. The timber to-day is worth on the stump something over $1,500.

The farmer had this strip of practically worthless sidehill, and with some spare time on hand dug up 1,400 seedling pines growing in a thicket and set them out. About 20 years later the farmer died and among his assets was this small tract of young pine for which, much to her surprise, the widow was offered $300. The second owner retained it for about 15 years and then, wishing some money, sold it. Soon afterwards it came into the hands of the present owners, a lumber company, for something over $1,000.

Assuming a land value of $5 per acre, and a charge for taxes and oversight for the period averaging $2 per acre per year, the operation has yielded a return of 5 per cent on the total investment in land, labor, and annual outlay, and in addition a neat sum equivalent to a yearly net profit from the start of over $5 per acre.

Forest-tree planting is practicable as a means of improving the quality of the woodland and increasing the quantity and value of its product. Through carelessness, cutting, fire, and other agencies many woodlands have fallen far below their maximum capacity of production. By the application of a little intelligent guidance in making proper improvement cuttings and by affording protection from grazing animals and fire it is often possible within the period of a few years to bring about a marked change for the better in the composition and quality of the woodland. This method often succeeds better than planting trees. This is illustrated by the experience of woodland owners. A progressive farmer in Summit County, Ohio wishing to handle his woodlands rightly, excluded all live stock by fencing and at the same time planted catalpa in the larger openings in his woods. In 10 years the forest floor, instead of being bare and packed hard, consisted of a deep layer of spongy organic matter affording protection to the roots of the trees. A complete understory of young yellow or tulip poplars, hard maple, beech, elm, white oak hickory, and ash had sprung up. The volunteer poplars, it should be carefully noted, had grown to from 6 to 12 feet in height and completely overtopped and suppressed the planted catalpa. Since the poplars were the more valuable of the two species because of their rapid rate of growth and the useful quality of the lumber, nature had beaten the owner at his own game. By making proper thinnings then, in 5 years the woodland was brought to the very satisfactory condition of having a good stand of valuable species of trees filling all the openings and coming on to take the place of the mature trees as cut.

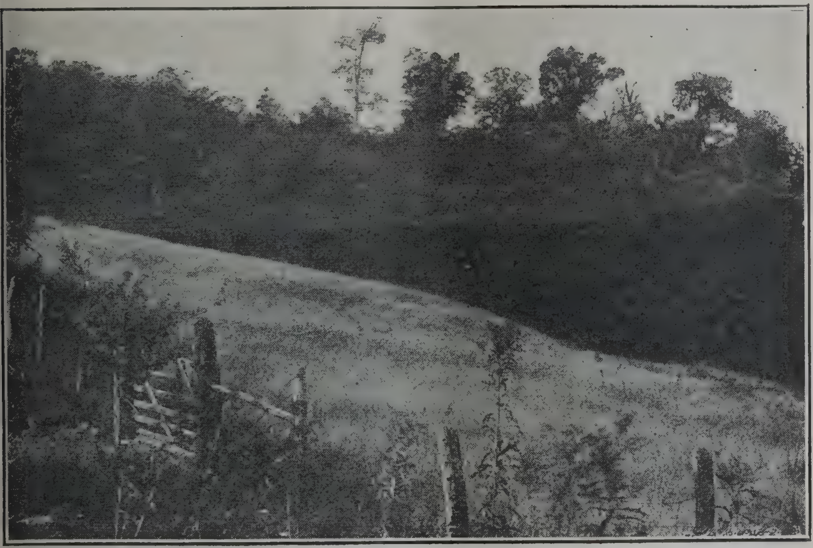
In choosing species for planting it is always best to consider first the most desirable kinds of native trees, since they are already acclimated to the local conditions and are least subject to failure. In general, the various conifers, including the pines, are to be recommended for planting in most sections of the country because they are quick growing and yield softwood, which is in more demand than the hardwoods. Cottonwood, which holds the record for the fastest production of wood, is a good tree for relatively moist situations of good soil. Black locust takes root quickly on dry slopes and possesses to a marked degree the ability to hold the soil against agents of erosion. (Fig. 12.) It is somewhat limited in its range of successful growth by a locust boring beetle, which, however, can be controlled to a great extent by means of proper spacing and handling of plantations.[1] Black walnut is probably one of the best kinds of trees for the farm, owing to the high quality and value of its wood nd its production of edible nuts. The more desirable trees for the arm to be favored in planting over a large region of the Eastern States include also the faster-growing red oaks, white oak, ash, ickory, and yellow poplar.[1]

---

[1] Refer to U. S. Department of Agriculture Bulletin 787, "Protection from the Locust Borer."

The planting of forest trees for shade, nut production, and ornamental purposes, as the original timber becomes scarcer, has an increasing place of importance on our farms and likewise in the towns nd cities.

Information regarding the kinds of trees, ways of obtaining seed r seedlings, methods of sowing and planting, and the care of trees an be had upon application to the various State foresters or the Forest Service, U. S. Department of Agriculture. Some of the State foresters, in addition to furnishing information, supply tree eedlings of the most desirable species at cost prices.



F-39292A

FIG. 12.—Black locust planted on waste land, supplying the farm with fence posts and enriching the soil.

Next to the improvement of existing woodlands by proper handling and good methods of marketing the products, no branch of farm forestry is of greater importance than forest planting.

ADDITIONAL INFORMATION.

(1) Additional information on forestry may be secured by writng to the Forester, Forest Service, Washington, D. C. A list of available forestry publications can be obtained, including those bear-

---

[1] Much practical information on what to plant and how to plant forest trees is found n Farmers' Bulletin 1085, "Growing and Planting Hardwood Seedlings on the Farm."

ing directly on the subject of forestry for the farm. Some of th
more important are:

Basket Willow Culture (Farmers' Bulletin 622).
Care and Improvement of Farm Woods (Farmers' Bulletin 711).
Measuring and Marketing Farm Timber (Farmers' Bulletin 715).
Cooperative Marketing of Woodland Products (Farmers' Bulletin 1100).
Preservative Treatment of Farm Timber (Farmers' Bulletin 744).
Waste Land and Wasted Land on Farms (Farmers' Bulletin 745).
The Windbreaks as a Farm Asset (Farmers' Bulletin 788).
Advice to Forest Planters in the Plains Region (Farmers' Bulletin 888).
The White Pine Blister Rust (Farmers' Bulletin 742).
Machinery for Cutting Firewood (Farmers' Bulletin 1023).
Making Woodlands Profitable in the Southern States (Farmers' Bulleti
1071).
Growing and Planting Hardwood Seedlings on the Farm (Farmers' Bulleti
1085).
Beautifying the Farmstead (Farmers' Bulletin 1087).
Street Trees (Agricultural Department Bulletin 816).
The Status and Value of Farm Woodlots in the Eastern United States (Agri
cultural Department Bulletin 481).
Use of Wood for Fuel (Agricultural Department Bulletin 743).
Small Sawmills (Agricultural Department Bulletin 718).
Protection from the Locust Borer (Agricultural Department Bulletin 787).
Protection of Forests from Fire (Forestry Bulletin 82); price, 15 cents.

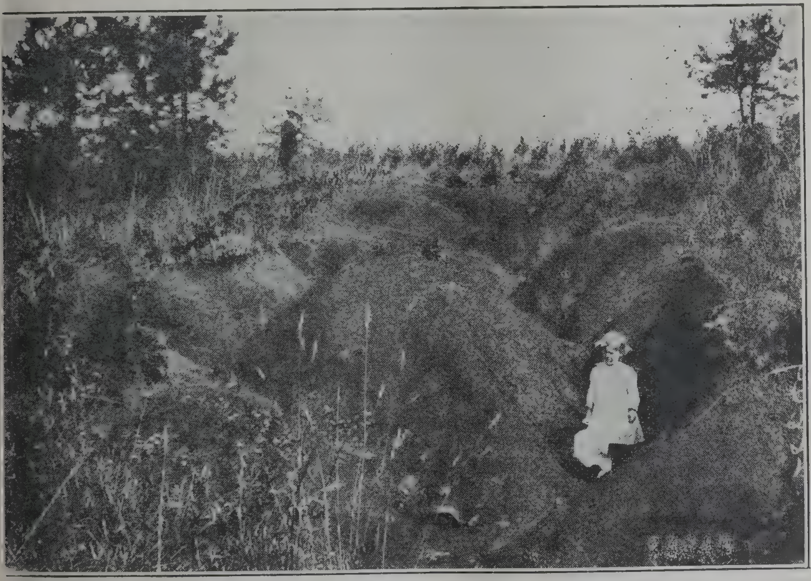
(2) Circulars or bulletins on various phases of home forestry hav
been published by most of the State foresters. No attempt is mad
here to list these publications, but applications for information o
forestry should be addressed to the various extension specialists i
forestry connected with the State agricultural colleges, to the count
agents, or to the State forestry departments, as follows:

State.	Official.	Address.
Alabama	State commisssioner of forestry	Montgomery.
California	State forester	Sacramento.
Colorado	State forester	Fort Collins.
Connecticut	State forester	New Haven.
Idaho	State commissioner of forestry	Boise.
Indiana	Secretary, State board of forestry	Indianapolis.
Iowa	State forestry commissioner	Des Moines.
Kansas	State forester	Manhattan.
Kentucky	Commissioner of geology and forestry	Frankfort.
Louisiana	Superintendent of forestry	New Orleans.
Maine	Forest commissioner	Augusta.
Maryland	State forester	Baltimore.
Massachusetts	State forester	Boston.
Michigan	State forester	Roscommon.
Minnesota	State forester	St. Paul.
Montana	State forester	Helena.
New Hampshire	State forester	Concord.
New Jersey	State forester	Trenton.
New York	Superintendent of forests	Albany.
North Carolina	State forester	Chapel Hill.
North Dakota	State forester	Bottineau.
Ohio	State forester	Wooster.
Oregon	State forester	Salem.
Pennsylvania	Commissioner of forestry	Harrisburg.
Rhode Island	Commissioner of forestry	Chepachet.
South Dakota	Forest supervisor	Custer.
Tennessee	Forester of State geological survey	Nashville.
Texas	State forester	College Station
Vermont	Chief forester	Montpelier.
Virginia	State forester	University.
Washington	State forester	Olympia
West Virginia	Forest warden	Philippi.
Wisconsin	Conservation commissioner	Madison.

(3) Sets of about 50 colored lantern slides, each, accompanied by a
ilabus, or lecture, will be loaned to schools and other educational
encies by the Forest Service for short periods on condition that
rrowers agree to pay transportation charges, to be responsible for
des lost or broken, and to forward the slides promptly and in good
ndition upon request. Application should be made as far in ad-
nce of the need as possible, since the sets are usually engaged for
considerable time in advance. The subjects upon which sets are
ailable are:

restry in Agriculture.
rm Forestry in the South.
ee Windbreaks.
eet Trees.
rm Woodlands.
ture Study and Forestry.
tany and Forestry.
Manual Training and Forestry.
Geography and Forestry.
Life of a Tree.
Conservation of the Forest.
Forestry in the United States.
The Work of the Forest Service.
Recreation on National Forests.

Application should be made to the Forester, Forest Service, Wash-
igton, D. C., for the loan of any of the above sets of lantern slides.



F-23849

FIG. 13.—Forest trees needed to check soil erosion and make land bring an income.

WOODLANDS on farms in the eastern half of the Unite States would form a strip 105 miles in width reachin from New York to San Francisco.

Farmers own as much forest land as do all the lumberme and other private holders together.

Farms contain more than one-half the entire hardwood fores area of the United States.

Woods occupy a larger part of the farms of this country tha does any other crop; in fact as much as all the cereal crop combined.

The haphazard cutting of trees with no plan or thought fo the future invariably results in the deterioration of the woods both in quality and value. Often the rapid-growing, straigh trees are cut because they can easily be worked up, and ye these are the very ones that should be left to develop into high-grade timber.

Using good pasture land to support scrub stock and devotin woodland to the growing of inferior trees are both examples o mismanagement on the farm.

Many woodlots on farms consist of park-like stands of defective trees having little commercial value. The forest shoul be so dense that little grass can grow. If stock need additiona shade some woodland may be included in the pasture. Th attempt to combine stock grazing with timber growing in farn woods is neither good grazing practice nor profitable forestry

A forest without young growth is like a community of ol people; it will die out.

Timber is a national necessity; the supply of it is being rapidly depleted. By growing more timber, the farmer increase his own income and benefits the public.

On the poorer lands of many farms in the United States whit pine, ash, oak, hickory, poplar, black walnut, cottonwood, blac locust, shortleaf pine, or slash pine is the best-paying crop.

On remote farms, where buyers formerly would make n offer on less than a carload of timber, good roads and the moto truck have made it possible for the farmer to sell individua trees at fair prices.

On account of big increases in prices the total value of th timber product for farm woodlands in 1919 is estimated to hav risen to about double that of 1910, or to about $400,000,000.

FORESTRY INCREASES FARM INCOME BY

1. Making waste lands yield a profit by growing timber on

Poor soils	Wet lands
Steep slopes	Unused corners
Rocky lands	Eroded lands.

2. Furnishing paying employment for men and teams during the winter.
3. Utilizing timber better on the farm and avoiding waste by
    - Cutting low stumps and small tops,
    - Using substitute woods in construction,
    - Treating nonlasting woods.
4. Increasing crop yields by planting forest tree windbreaks.
5. Growing more and better timber on the farm through
    - Protecting the woods from fire and overgrazing,
    - Selecting for cutting the mature, defective, overcrowded, and inferior kinds of trees, and leaving the straight, thrifty, and better kinds,
    - Planting to fill openings in woods.
6. Marketing the higher grades of wood products direct to consumers at fair prices as

Saw logs	Posts
Poles	Pulpwood
Piling	Firewood
Cooperage bolts	Spoke blocks
Handle bolts	Tannin bark.

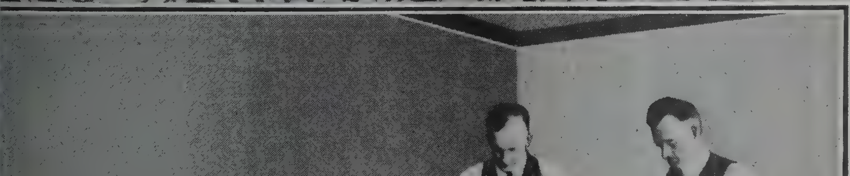
MAKE YOUR WOODLAND PERMANENTLY PROFITABLE.

Good Timber Wasted by Woods Fires

FARMERS' BULLETIN 1118

Jnited States Department of Agriculture

DOCKAGE UNDER THE FEDERAL WHEAT GRADES



SOME DOCKAGE MAXIMS

THE PERCENTAGE OF DOCKAGE is an essential factor in arriving at the true value of a lot of wheat. This dockage may consist of either useful or harmful foreign materials.

The various methods of handling dockage should be carefully investigated and the one that is best suited to the needs of the local conditions should be adopted.

When a large percentage of dockage is present in wheat it is advisable to remove it on the farm or at the point of shipment and thus avoid paying the freight for the dirt, chaff, weed seeds, etc., on the basis of the rate for wheat.

The farmer should get a higher numerical grade for his wheat under the dockage system of the Federal grades than he would under a system of grading that does not require a determination for dockage but lowers the grade on account of the total foreign material present in the wheat marketed at country points.

The dockage system in operation protects the farmer from the possibility of low prices fixed by the local buyer in order to insure a safe purchase on a flat-rate basis.

Contribution from the Bureau of Markets
GEORGE LIVINGSTON, Chief
Washington, D. C. March, 1920

OCKAGE UNDER THE FEDERAL WHEAT GRADES.[1]

RALPH H. BROWN,
Grain Supervisor, Bureau of Markets.

CONTENTS.

	Page.
ckage described	3
reign material in wheat	5
ockage" and "Foreign material other than dockage" distinguished	5
lue of dockage	7
tailed description of method of etermining dockage:	
Certain foreign material designated dockage	8
How to secure the sample for inspection	8
Equipment for separating dockage	9
Detailed description of method of determining dockage—Continued.	
How to use the hand sieves	10
Test weight determined on dockage-free wheat	20
Grading the dockage-free sample	20
Practical methods of handling dockage	21
A few improper methods of applying dockage	22
Securing information relative to dockage	23
Tabulated wheat standards	24

DOCKAGE DESCRIBED.

N GRADING WHEAT under the Federal standards one of the fundamental principles is to determine the numerical grade on a dockage-free basis; that is, the dockage is first removed from the mple and the grade determination is made on the clean or dockage-ee wheat. A few exceptions to this principle are noted in the llowing pages.

What is dockage? It is the foreign material screened from a mple of wheat to be graded, by the use of appropriate hand sieves ee fig. 1), or other cleaning devices, such as those approved by the nited States Department of Agriculture. It consists of sand, dirt, eed seeds, weed stems, chaff, straw, grain other than wheat, any her foreign material, and in certain cases some finely broken and nall shriveled kernels of wheat.

The purpose of the dockage provision in the wheat standards is to able the person grading the representative sample to determine the

---

[1] The method of determining dockage in wheat recommended by the Department of riculture in Farmers' Bulletin 919 was based on the official grain standards of the ited States for wheat made effective on July 1, 1917, for winter wheat and on August 1917, for spring wheat. The official grain standards for wheat of all classes were vised, effective July 15, 1918, and this publication sets forth the recommendations of department on the determining of dockage under the revised grades.

In grading the dockage-free sample of wheat, the factor "Foreig material other than dockage" (see columns 9 and 10 of the table on page 24) is further considered under two headings, namely "Cereal grains" and "Matter other than cereal grains." "Cerea grains" include rye, barley, emmer, spelt, einkorn, corn, grain sorghums, oats, and rice only. "Matter other than cereal grains" ir cludes weed seeds, buckwheat, flaxseed, wild oats, and dirt. A cei tain total limit, which includes the entire amount of this foreig material in the dockage-free sample, is specified for each grad Within this total, however, the "Matter other than cereal grains (weed seeds, etc.), has a special limitation. The percentage of wee seeds permitted within each grade is smaller than that for "Cerea grains" because the former more seriously affects the milling valu of wheat than does the "Cereal grains," and these weed seeds ma have ingredients which are positively harmful.

Referring to the heading "Foreign material other than dockage in the tabulated and abridged grade requirements for the Federa grades on page 24, a few examples will be cited to illustrate th grade requirements:

1. If the foreign material in the dockage-free sample of whea consists of rye and small oats kernels only (cereal grains): 1 per cent is permitted in Grade No. 1, 2 per cent in Grade No. 2, et (See "Total" column.)

2. If the foreign material in the dockage-free sample consist of chess (cheat) and cockle only (matter other than cereal grains) ½ per cent is permitted in Grade No. 1, and 1 per cent in Grade N 2, etc. (See "Matter other than cereal grains" column.)

3. If the foreign material in the dockage-free sample consists c rye (cereal grains) and cockle (matter other than cereal grains and if ½ per cent is cockle, then only ½ per cent may be rye for th Grade No. 1, as the total foreign material for this grade must nc exceed 1 per cent. If 1½ per cent is cockle, the sample will grad No. 3 on account of the factor "Matter other than cereal grains, and the rye in this case must not exceed 1½ per cent, as the total lim for the grade is 3 per cent.

Cereal grains and matter other than cereal grains may be eithe "Dockage" or "Foreign material other than dockage," and th classification under the Federal grades depends on whether the material is separated from the sample by the use of the appropriat sieves. If separated, it is classified as "Dockage." If it is not separated, it becomes a factor in the grading under the heading "Foreign material other than dockage." (See figs. 2 and 3.)

Ordinarily the foreign material classified as dockage can be removed from the wheat with comparatively simple cleaning machiner such as is installed in many of the grain elevators and mills, or can be removed on the farm with an ordinary portable fanning mill equipped with screens having perforations like those specified for the dockage sieves.

VALUE OF DOCKAGE.

Dockage found in wheat in many cases is of real value, while in other cases it not only may have no value but often may contain ingredients that are positively harmful if ground with the wheat.[1] Therefore the value of dockage depends on the value of the material separated from the wheat. Dockage frequently contains quantities of nutritious grain and weed seeds, as mustard, flaxseed, oats, or other cereal grains; much of this material can be used to good advantage as poultry feed or stock feed. Wild mustard and flaxseed can be removed from the dockage in practically a pure state by the use of special cleaning machinery such as is sometimes found in terminal elevators and the larger flour mills, and when so separated will command a good price. The farmer, of course, should receive a reasonable return for this valuable dockage.

However, when dockage consists of dirt, sand, and other material of no value, or of material containing ingredients that are positively harmful when ground with wheat, the dockage contained in the wheat amounts to a specific loss, when the entire lot is purchased for food purposes, and necessitates extra expense in cleaning the wheat to make it suitable for human consumption.

The farmer or grain dealer, of course, does not expect the purchaser to pay wheat prices for dirt, objectionable weed seeds, sand, chaff, weed stems, and straw. If the dockage system is not employed, such foreign material may cause a lowering of the grade. If no grading system is employed and the country miller or grain dealer buys wheat as delivered at a flat rate, or on the basis of the average quality delivered, the price paid is sufficiently low to protect him against loss caused by the objectionable foreign material delivered with the general run of the grain. Under the dockage system of the Federal standards, however, the amount of such foreign material separated and considered as dockage may be deducted from the weight of the wheat purchased, and in any event does not affect the grade of the clean wheat. This results in a higher grade and the price paid is on the basis of this grade for the dockage-free wheat. In other words, the grain dealer or miller who purchases wheat containing such foreign material does not pay wheat prices for dirt, etc., under any system of grading. Where the country buyer is obliged to sell his wheat, purchased from the farmer, in large markets where the Federal standards are applied, it is desirable that he correctly apply th standards and the dockage system in his wheat purchases so that may purchase and sell the commodity on the basis of the same of grades.

---

[1] The injurious effects on the milling and baking qualities of straight flour made from wheat containing various kinds of impurities are given in detail in United States Department of Agriculture Bulletin 328, "Milling and baking tests of wheat containing admixtures of rye, corn cockle, king head, and vetch," 1915.

Where the flat-rate method of purchase is followed, farmers wi little or no dockage in their grain are often obliged to sell th wheat at the same price as wheat containing dockage. Therefo where the dockage system is properly employed, the farmer or gra dealer who delivers grain with little or no separable foreign mater in it receives full value for his wheat and is not obliged to take l than it is worth in order that other farmers or dealers may recei the same market price for wheat containing weed seeds and other jectionable separable foreign material. If the dockage system properly employed, the purchaser can base the price upon the trinsic value of the dockage-free wheat, and then take into consider tion the value, if any, of the dockage present, as evidenced by t kind and amount determined and the expense incurred in separati it from the wheat.

DETAILED DESCRIPTION OF METHOD OF DETERMI ING DOCKAGE.

CERTAIN FOREIGN MATERIAL DESIGNATED AS DOCKAGE.

In the revised Official Grain Standards of the United States f Wheat, fixed and promulgated by the Secretary of Agriculture April 13, 1918, effective July 15, 1918, and published in Service a Regulatory Announcements (Markets) No. 33, a certain character foreign material in wheat has been designated as "Dockage," whi is defined as follows:

> Dockage includes sand, dirt, weed seeds, weed stems, chaff, straw, grain ot than wheat, and any other foreign material, which can be removed readily fr the wheat by the use of appropriate sieves, cleaning devices, or other practi means suited to separate the foreign material present; also undeveloped, shr eled, and small pieces of wheat kernels removed in properly separating foreign material, and which can not be recovered by properly rescreening or cleaning. The quantity of dockage shall be calculated in terms of percenta based on the total weight of the grain including the dockage. The percenta of dockage so calculated, when equal to 1 per centum or more, shall be stated terms of whole per centum; and when less than 1 per centum shall not be stat A fraction of a per centum shall be disregarded. The percentage of docka so determined and stated, shall be added to the grade designation.

HOW TO SECURE THE SAMPLE FOR INSPECTION.

In the inspection and grading of grain under the official standar it is important that the grading be done on the basis of a represent tive average sample of the lot. Section 7 (as amended) of regulation 5 of the Regulations of the Secretary of Agriculture under the United States grain standards Act outlines what is deemed a representative sample, as follows:

> SEC. 7. For the purposes of an appeal or a dispute no sample shall be deemed to be representative unless it comply with the following requirements:
>
> Paragraph 1. It shall be at least 2 quarts in size, of which at least 1⅛ pints shall be inclosed in a clean air-tight container, and the remainder, if any, in a clean cloth sack.
>
> (NOTE.—Many farmers and interior grain dealers prefer to place the entire sample in an air-tight container for mailing to an inspector. If this practice is followed, care should be taken to see that the container is clean and the wheat is dry and the time necessary for the delivery through the mails does not exceed a day or two.)
>
> Paragraph 2. In case of bulk grain in a carload lot or in a wagon, at least five probes, and as many more as may be necessary, in the discretion of the sampler, shall be taken from the grain in different parts of the car or wagon, as the case may be.
>
> Paragraph 3. In case of bulk grain in a canal boat, barge, ship, or other vessel, at least five probes, and as many more as may be necessary, in the discretion of the sampler, shall be taken from the grain at different points through each hatch or opening in the deck, except that, when it is impractical to obtain a sample in accordance with the foregoing portion of this paragraph, it may be drawn from the grain stream while running from the spout or on the belt or other conveyor to or from the vessel, if taken in such a way as to show an average of the entire lot.
>
> Paragraph 4. In case of grain in sacks, samples shall be drawn from such number of sacks selected at random from the entire lot as will, in the judgment of the sampler, show an average of the lot, except that, if the grade of each individual sack be in question, a sample shall be drawn from each sack.
>
> Paragraph 5. In case of grain in an elevator or warehouse, or in any other case not covered in this section, samples shall be taken from as many different portions of the lot or parcel as will, in the judgment of the sampler, show an average of the lot or parcel.
>
> Paragraph 6. The grain taken from the different portions of a lot or parcel shall be thoroughly mixed, and such mixture, or a typical portion thereof, otherwise complying with this regulation, shall constitute a sample of the entire lot or parcel.

EQUIPMENT FOR SEPARATING DOCKAGE.

In determining the quantity of dockage in connection with the official grading of wheat the following cleaning devices are used in the offices of Federal Grain Supervision:

1. A small wheat tester or device for removing barley, oats, wild oats, pieces of straw, weed stems, and other coarse matter from wheat.

   This is a modified form of the machine already in general use in the spring wheat belt, where the dockage system has been practiced for many years. On account of the peculiar short, jerky motion of the riddle, this machine has been popularly designated as the "wild oat kicker." (See fig. 4.)

2. Set of perforated metal hand sieves consisting of—
   - (*a*) Bottom pan; inside diameter should be 13⅛ inches; depth, 2½ inches and roll at top of pan three-sixteenths inch in diameter.
   - (*b*) Buckwheat sieve, with triangular perforations eight-sixty-fourth inch on each side of perforations; inside diameter of sieve should b 13 inches; depth of sieve, 2 inches; and roll at top of sieve, on fourth inch in diameter.
   - (*c*) Fine-seed sieve, with round perforations one-twelfth inch in diamete (Other specifications and dimensions same as for (*b*) buckwhe sieve above.)
   - (*d*) Fine chess sieve, with slotted perforations 0.064 inch wide and thre eighths inch long. (Other specifications and dimensions same for (*b*) buckwheat sieve above.)
   - (*e*) Coarse chess sieve, with slotted perforations 0.070 inch wide by on half inch long. (Other specifications and dimensions same as f (*b*) buckwheat sieve above.)
   - (*f*) Scalper sieve, with round perforations twelve sixty-fourths inch diameter, depth of 1½ inches; inside diameter should be 12⅞ inche and roll at top of sieve five-sixteenths inch in diameter.

NOTE.—Sieves (*b*), (*c*), (*d*), and (*e*) should be made to nest very freely with the bott pan. The scalper sieve (*f*) should nest very freely with each of the other thr sieves and also with the bottom pan.

The shape and arrangement of the perforations in the different sieves are illustrat in figure 5, and the manner of nesting the sieves is shown in figure 1.

It is absolutely essential for the purpose of uniformity in i spection that the dimensions of the perforations of the sieves use be exactly as stated above. A slight variation in the dimensio materially influences the percentage of dockage obtained. In ord to secure the exact size it is necessary that the perforations be c with dies especially made for the purpose. Sieves made with a ordinary punch from tin or galvanized iron will not give accura results.

From experiments in hand screening and cleaning various kin of foreign matter from wheat, it has been found that with prop care the metal sieves with perforations as indicated above, wh used in connection with the wild-oat separator, will give a practic determination of dockage.

HOW TO USE THE HAND SIEVES.

In determining dockage such sieve or sieves should be used will remove the foreign material with the least possible loss of whe including small plump, or badly shriveled kernels, or large pieces broken kernels. As a general rule, the use of the fine-seed sieve wi round perforations $\frac{1}{12}$ inch in diameter, together with the scalp sieve or the "wild oat kicker," will be sufficient. (See fig. 6.) Ho-ever, if the sample contains an appreciable quantity of wild buc-wheat, pigeon grass, or other seeds of a similar character, or forei material, none of which will pass through the fine-seed sieve, th the buckwheat sieve should be used. (See fig. 7.)

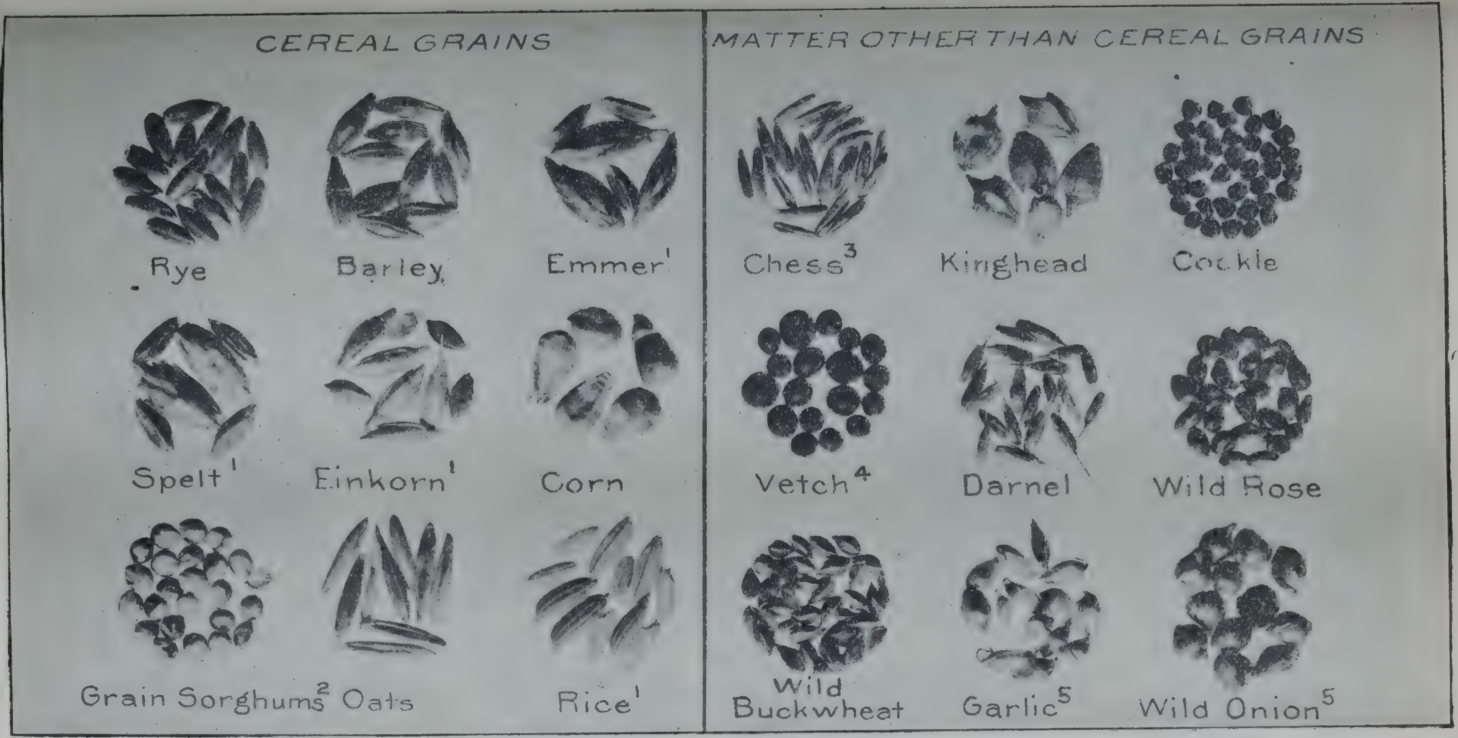


FIG. 2.—Foreign material partly illustrating the grading factors "Cereal grains" and "Matter other than cereal grains" (actual size). Whether this material is considered as "Dockage" or "Foreign material other than dockage" depends upon whether it is separated by the appropriate sieves. If separated it is "Dockage"; if not separated, "Foreign material other than dockage," and is a factor in the grading. 1, Hulled and unhulled kernels; 2, grain sorghums include kafir corn and milo maize; 3, chess (cheat); 4, includes hairy vetch and common vetch; 5, wheat containing garlic or wild onion bulblets in a quantity equal to 1 or more bulblets in 1,000 grams causes it to be graded "Garlicky."

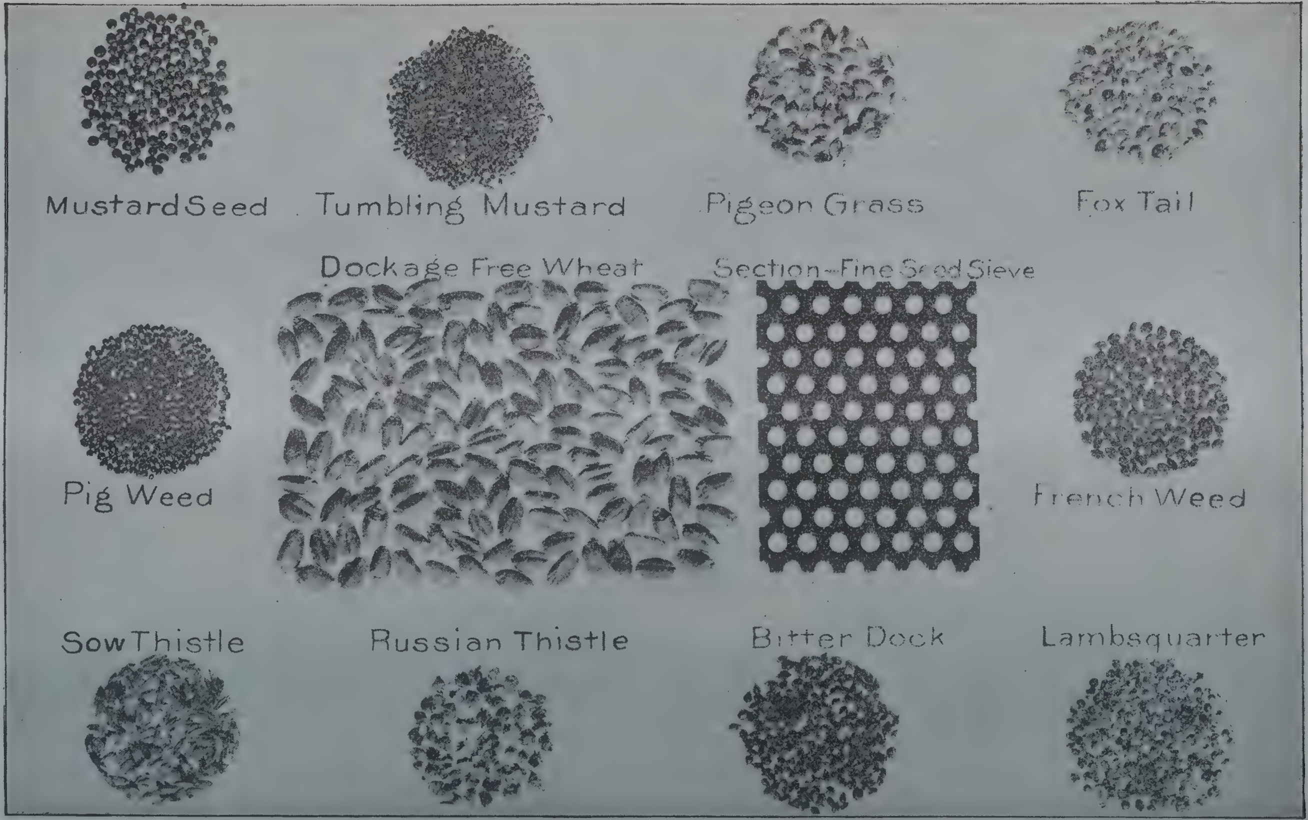


FIG. 3.—Some of the common small weed seeds (actual size) found in wheat and generally considered "Dockage." These seeds are usually separated by the fine seed sieve with round perforations one-twelfth inch in diameter. Pig weed, Russian thistle, and lambsquarter are considered as having good feeding value, but, because of their small size, should be ground. Pigeon grass and fox tail are comparable to light millet for feed, while black and Chinese mustard are pungent, and tumbling mustard, French weed, and bitter dock are objectionable in feeds in any considerable quantity.

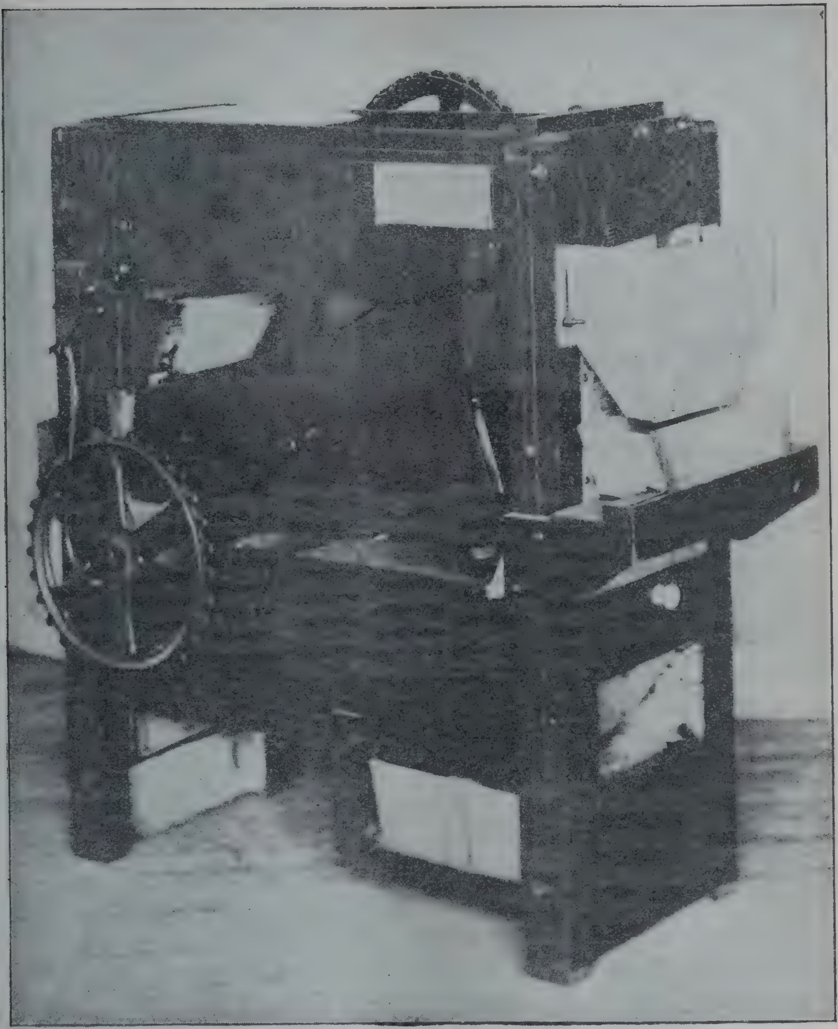
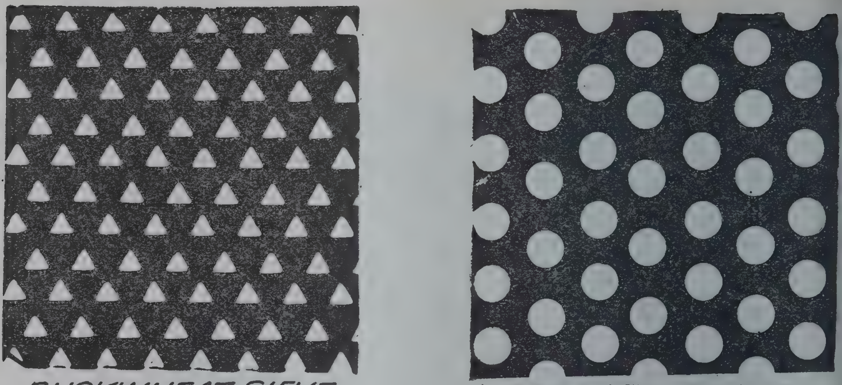
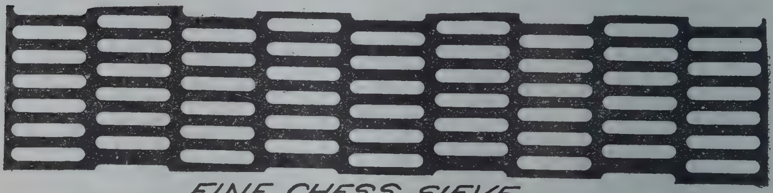


FIG. 4.—Wheat tester often used for removing coarse material in determining dockage. The tester is used to remove barley, oats, wild oats, pieces of straw, weed stems, and other coarse material from wheat. This is a modified form of a machine which had been in use in the spring wheat belt, where the dockage system has been practiced for years. The sample is placed in the hopper in the top (left), from which it flows slowly upon a riddle. The riddle is caused to have a series of short, jerky motions by means of the turning of the wheel shown at the rear of the machine. On account of this peculiar short, jerky motion of the riddle, this machine has been popularly designated as the "wild-oat kicker." The coarse material is "kicked" up each step of the riddle until it falls into the hopper and pan on the right side near the top of the machine, while the wheat grains and fine material are separated by falling through onto a sieve and into the pans below. The fine material is separated from the wheat as the sample passes over the sieve.

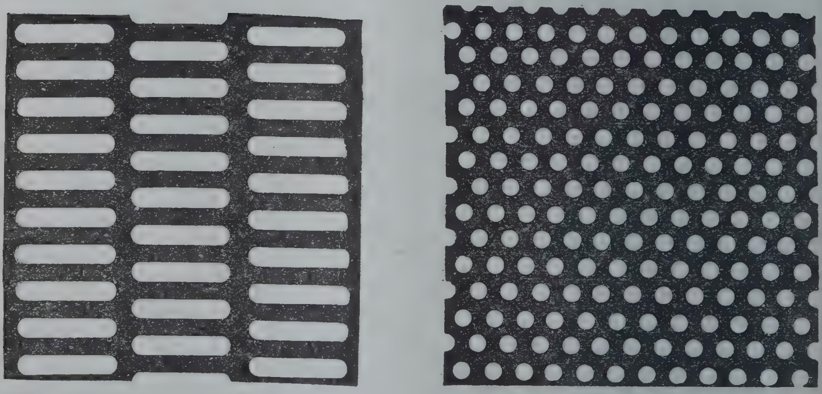


BUCKWHEAT SIEVE

SCALPER SIEVE



FINE CHESS SIEVE



COARSE CHESS SIEVE

FINE SEED SIEVE

FIG. 5.—Sections of dockage sieves illustrating the perforations (actual size) of the sieves. Buckwheat sieve, triangular perforations $\frac{8}{64}$ inch long on each side of perforation; scalper sieve, round perforations $\frac{12}{64}$ inch in diameter; fine chess sieve, slotted perforations 0.064 inch wide by $\frac{3}{8}$ inch long; coarse chess sieve, slotted perforations 0.070 inch wide by $\frac{1}{2}$ inch long; fine seed sieve, round perforations $\frac{1}{12}$ inch in diameter.

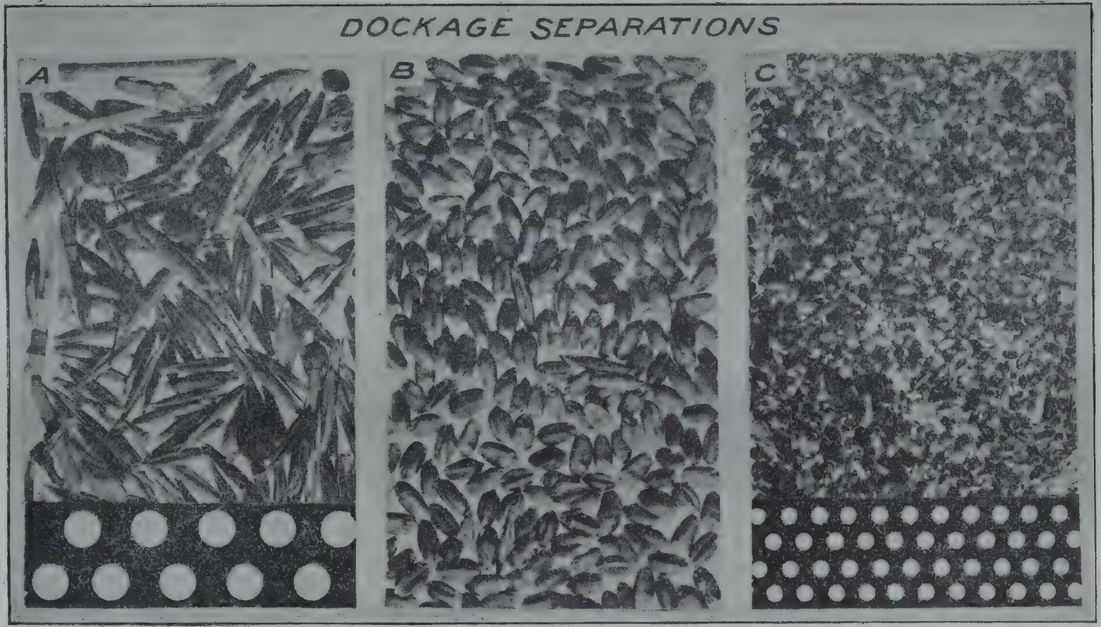


FIG. 6.—Separations made and sections of sieves used (actual size) in determining dockage when the separable foreign material consists of only oats, chaff, straw, weed stems, and similar coarse material, and sand, fine seeds, and similar fine material. A, Section of scalper sieve and character of material separated; B, dockage-free wheat; C, section of fine seed sieve and character of material separated. The material separated as shown in A and C together comprises the dockage.

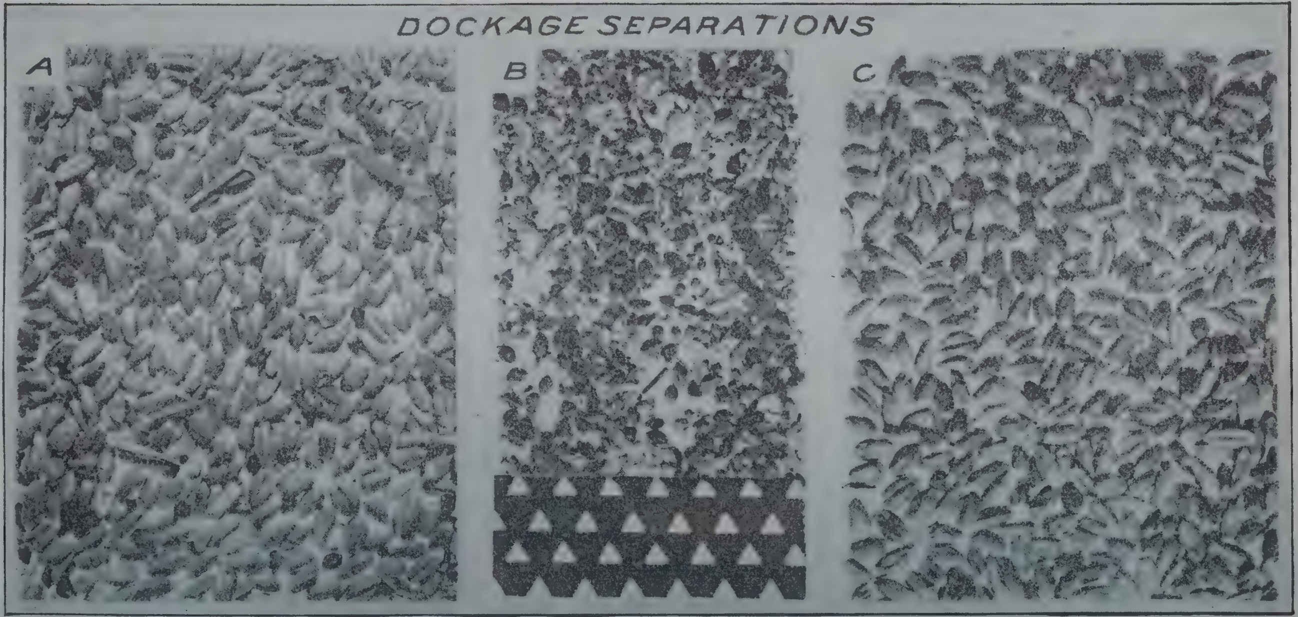


FIG. 7.—Separation made and a section of the sieve used (actual size) in determining dockage when the wheat contains only wild buckwheat and other foreign material, the pieces of which are sufficiently small to enable them to pass readily through the triangular perforations. A, Character of the sample before the removal of the dockage; B, section of buckwheat sieve and character of the material separated; C, character of dockage-free sample. Sometimes a certain amount of cracked wheat is also separated in the first screening of the sample, and in such cases it is necessary to carefully rescreen the material separated in order to recover as much of the cracked wheat to the sample as is practicable.

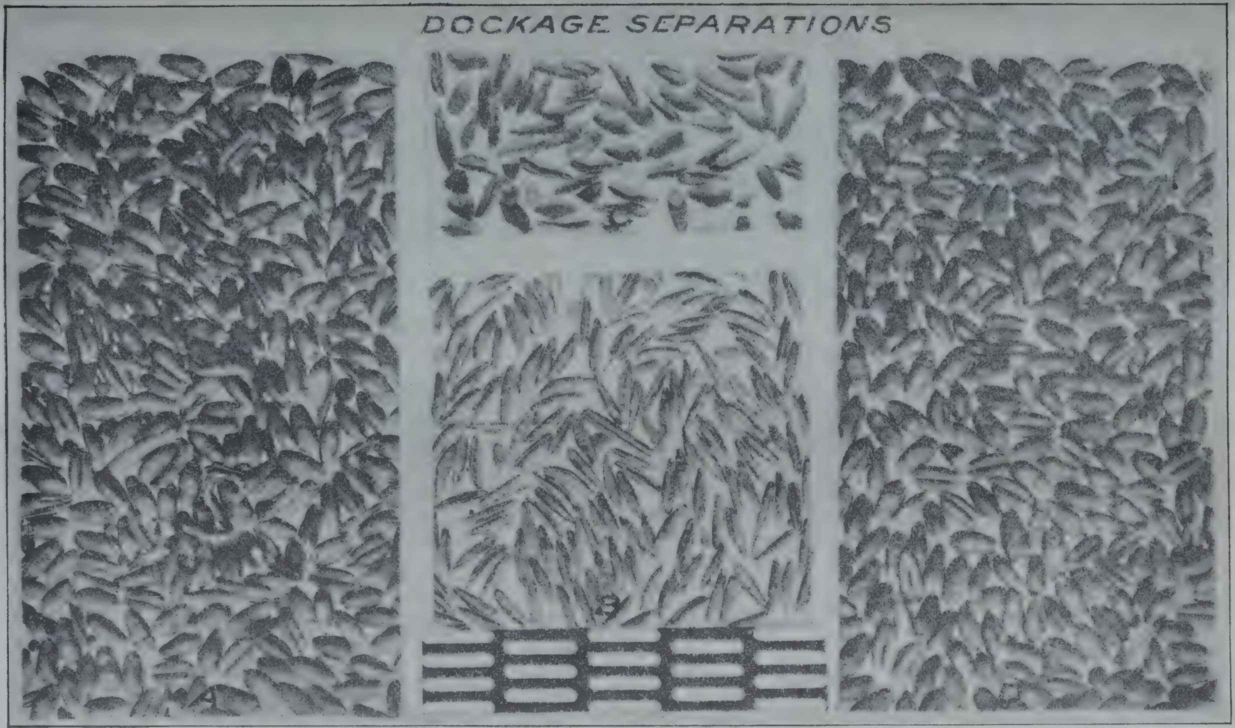


FIG. 8.—Separation made and a section of the sieve used (actual size) in determining dockage when the wheat contains only chess (cheat). A, Character of the sample before the removal of dockage; B, section of the fine chess sieve, and the character of the dockage; C, character of the material, including small shriveled or split wheat kernels, which is recovered to the wheat by carefully rescreening the material separated in the first screening (in rescreening the material first separated to recover the small shriveled or split kernels, some of the foreign material is also recovered); D, character of the dockage-free wheat.

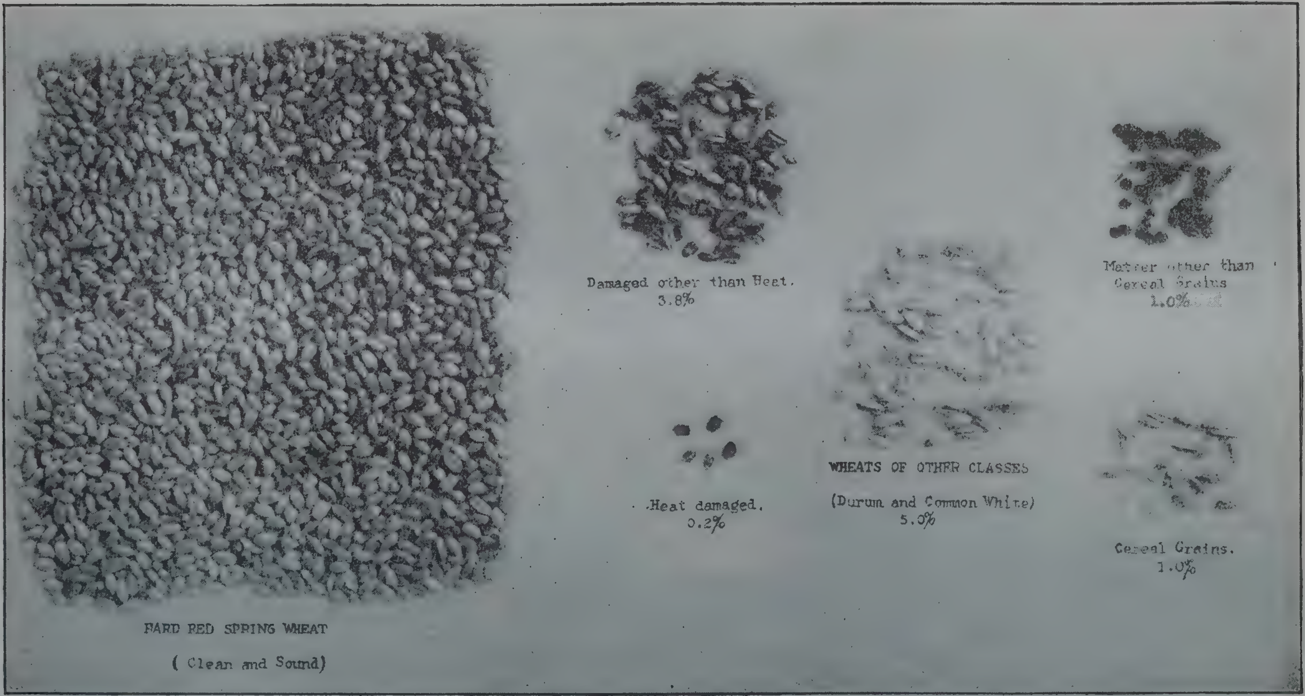


FIG. 9.—Separations illustrating various grading factors, including "Foreign material other than dockage" ("Cereal grains," and, "Matter other than cereal grains"). This dockage-free sample contains the maximum percentages of the factors shown, that are permitted in the No. 2 grade.

All material passing through the buckwheat sieve should be conidered as dockage, except that whenever the screenings removed by his sieve consist of an appreciable quantity of small shriveled kernels of wheat, the material so removed should be rescreened over the ame sieve.

In the rescreening, the material should be carefully deposited at one edge of the sieve, then while holding the sieve at an angle of 25 or 30 degrees, it should be tapped lightly until all material has passed either to the opposite edge of the sieve or through the perforations. If operated properly, the material at the opposite edge of the sieve will consist mainly of wheat and should be classed as wheat and not as dockage.

The material that passes through the sieve will consist mainly of wild buckwheat and other weed seeds, together with a small percentage of shriveled kernels and small broken pieces of wheat, and these should be classed as dockage. In exceptional cases it may be necessary to repeat the rescreening in order to arrive at an equitable determination of the percentage of dockage.

The chess sieves should not be used unless the sample in question contains an appreciable quantity of chess (cheat). (See fig. 8.) As a general rule, the chess sieves should likewise not be used until after the sample has been screened, either over the fine-seed or the buckwheat sieve, as the sample may require. Whenever it is necessary to screen for chess, the fine chess sieve with perforations 0.064 by $\frac{3}{8}$ inch should be used, except when the sample consists of wheat of large kernels mixed with large chess seeds. Large chess seeds in a sample of wheat consisting mainly of small kernels of wheat from which the chess can not be separated readily should be considered as "Foreign material other than dockage," and the sample should be handled and graded accordingly.

Whenever in the use of chess sieves the screenings consist of an appreciable quantity of small shriveled or split kernels, the material so removed should be rescreened over the same sieve, manipulating it as described for rescreening over the buckwheat sieve. In rescreening over the chess sieve, the material should flow with and not across the slots.

The scalper sieve is to be used for removing coarse foreign material. Any thrashed wheat kernels that remain on the scalper sieve should be picked out and returned to the wheat and should not be considered as dockage.

The dockage thus determined will consist, therefore, of the coarse foreign material in addition to the finer screenings obtained by hand sieving. Since any foreign matter remaining in the wheat after the removal of dockage is considered as "Foreign material other than dockage," and consequently directly affects the grade, great care should be used in sieving the samples.

TEST WEIGHT DETERMINED ON DOCKAGE-FREE WHEAT.

The Federal grades provide that each determination of dockage, moisture, temperature, odor, onions, garlic, and live weevils or other insects injurious to stored grain shall be upon the basis of the grain including dockage. All other determinations shall be upon the basis of the grain when free from dockage. Since the test weight per bushel is one of the main factors in determining the grade, the dockage should be determined with a sufficient quantity of the original sample to provide at least enough dockage-free wheat for making the test weight with a pint tester, and preferably the dockage should be removed from a sufficient quantity of wheat for obtaining the test weight with a quart tester. The offices of Federal Grain Supervision have instructions to make the weight per bushel test with a quart tester. (See fig. 10.) Under average conditions a sample of 1,000 grams (about 2¼ pounds) will be a sufficient amount for determining the test weight with a quart tester. However, if the wheat contains a large amount of coarse material and other foreign matter, it will sometimes be necessary to remove the dockage from more than 1,000 grams, in order to secure a sufficient quantity of dockage-free wheat to make the test weight with a quart tester.

GRADING THE DOCKAGE-FREE SAMPLE.

After the dockage is removed from the original sample and the test weight per bushel has been determined, the sample is then examined to ascertain if an analysis is to be made for any other factors provided for in the Federal standards that will determine the grade. (See fig. 9.) While provision is made in the standards for many factors that affect the quality and condition of wheat, the actual practice of grain inspectors is to make the test for only the factor or factors that are necessary to determine the grade for any one sample. An experienced grain man is able to ascertain generally the factor or factors that must be accurately determined. Therefore, if the dockage-free sample is found to have considerable foreign material present that will cause it to be a grading factor, the sample is reduced in size by thoroughly mixing and dividing it, preferably in the Boerner sampling device, to a size of approximately 50 grams (about 2 ounces), to permit of rapid analysis. This small portion or subsample is then weighed, and the foreign material is taken out of the sample by hand picking. The "Matter other than cereal grains" (weed seeds, dirt, and similar material not separated as dockage) is placed together, and the "Cereal grains" (rye, barley, oats, etc.) are placed together. The "Matter other than cereal grains" is weighed first, because it is specially considered in the grades, and the percentage, by actual weight, is determined. Then the "Cereal grains" are weighed and the percentage determined, in order to ascertain the total "Foreign material other than dockage" in the sample. If, for example, the "Matter other than cereal grains" equals one-half of 1 per cent, then only one-half of 1 per cent of "Cereal grains" may be allowed in the sample if the wheat is to grade numerically No. 1, for the total "Foreign material other than dockage" must not exceed 1 per cent. If, however, there is no "Matter other than cereal grains" in the sample, 1 per cent or all of it may consist of "Cereal grains" and still grade numerically No. 1. This same procedure is maintained for each grade, except that the percentages are increased for the lower grades.

PRACTICAL METHODS OF HANDLING DOCKAGE.

All of the following methods of handling dockage are employed in normal times and all are generally found to be satisfactory:

1. The wheat is cleaned on the farm and only the clean wheat is hauled to market.
2. The wheat delivered by the farmer is run over the proper cleaning machinery at the country elevator or mill, and the dockage is separated and returned to the farmer.
3. The wheat is screened by the local buyer, payment is made to the seller on the basis of the grade of the clean wheat only, and the dockage is retained by the elevator or mill as compensation for services in removing it.
4. The wheat is screened by the local buyer, payment is made to the seller on the basis of the grade of the clean wheat, and the dockage is retained by the elevator or mill, and if the value of the dockage separated exceeds the cost of separation, payment is made for it.
5. The wheat containing the dockage is consigned to the large market by the country mill or elevator, where the dockage is separated and its value is taken into consideration in connection with the price paid for the entire carload of dockage-free wheat. In some localities it is the practice to make a small charge for such services, while in other localities the services are performed without cost.
6. The wheat containing the dockage is sold to a local buyer, who in turn consigns it to the terminal market with the understanding that the price secured will be based upon the commercial value of both the wheat and the dockage.

The first two methods mentioned, in which only the screened wheat is delivered to the local buyer, tend to minimize the differences of opinion with regard to the grade of wheat delivered and therefore establish greater confidence in the grades given by the local buyer. Furthermore, these methods enable the farmer to utilize the foreign material for feed or to sell it locally. When noxious weed seeds are present, it is advisable to have the removed dockage ground before feeding, to prevent the further spread of these weeds on the farm. In many cases such material has a relatively high value as feed, and it is believed that farmers will often find it to their advantage to remove the dockage themselves or to have their local buyers do it for them, even though it may be necessary to pay a small fee for the service.

When the dockage is separated by the local buyer and is retained by him as compensation for the extra labor involved, as well as for compensation for the additional time and equipment necessary to perform this service, as noted in the third method mentioned, it may be accumulated at the elevator or mill and disposed of by shipping to a terminal market in bulk, or, in cases of small accumulations, it may be sacked and sold locally for feed. The entire factor of dockage in farmers' cooperative elevators where each farmer is financially interested may be handled by this method. It means, of course, that any material of value in the dockage can be disposed of advantageously and the proceeds prorated at the end of a season's business among the farmers interested in the elevator.

When wheat containing dockage is consigned to a commission merchant at a terminal market, as noted in the sixth method mentioned, the commission merchant, under normal marketing conditions, will sell the wheat by exhibiting a sample on the exchange floor, or by some other method, and secure the best possible price for the grain contained in the car. Consideration is given not only to the value of the wheat itself but to the wheat plus the dockage, provided, of course, the dockage is composed of material having some commercial value. It is not unusual for a certain lot or parcel of wheat to contain a comparatively high percentage of dockage of this character. It should be the function and duty of the commission merchant at the terminal market to obtain the largest returns possible under the conditions.

A FEW IMPROPER METHODS OF APPLYING DOCKAGE.

The dockage system of the Federal standards was used in certain localities for the first time when the standards became effective. Because many farmers and country buyers were not familiar with the application of the new dockage system, the results were that in these localities the country buyers were often using improper methods of determining or applying dockage in the grading. A few of these improper methods which have come to the attention of the Department of Agriculture will be cited to illustrate.

An improper method used by dealers in some parts of the country was to determine the percentage of dockage and arbitrarily deduct this percentage from the weight of the grain purchased. This was done regardless of the value of the material separated. Sometimes this dockage was then returned to the sample, and the buyer determined the test weight per bushel on the basis of the wheat containing the dockage. This method is not in accordance with the Federal grading rules and may tend to decrease the test weight per bushel. In other instances a deduction was also made for foreign material present in the sample, including the material that had been separated previously as dockage, calculating the same material as a factor twice.

In other localities, a dockage assessment of 1 bushel per load of approximately 60 bushels was made regardless of the percentage of dockage present. It is evident that the practice of making an arbitrary assessment of dockage is unjust to the farmer and not only encourages the marketing of the wheat containing weed seeds and other separable foreign material but also greatly discourages the general improvement in marketing conditions and good farming methods.

SECURING INFORMATION RELATIVE TO DOCKAGE.

Further information as to the correct method of determining dockage in wheat may be obtained by writing the Department of Agriculture, Washington, D. C., or by writing to or visiting the nearest Office of Federal Grain Supervision. Offices of Federal Grain Supervision are located in the large grain markets.

A farmer or country grain dealer may also mail to the nearest licensed grain inspector a sample of wheat and receive, for a small fee, an official certificate showing the grade and the dockage on that particular sample. This sample should be at least 2 quarts in size, of which at least $1\frac{1}{8}$ pints is inclosed in a clean air-tight container, and the remainder, if any, together with the container, should be placed in a clean cloth sack. The name and address of the nearest licensed grain inspector can be secured by writing to the Department of Agriculture or to any supervision office.

TABULATED AND ABRIDGED GRADE REQUIREMENTS OFFICIAL GRAIN STANDARDS OF THE UNITED STATES FOR WHEAT.

[The numbered footnotes below must be read in connection with the tabulation.]

Grade No.	Minimum limits of test weight per bushel.			Maximum limits of—						
				Moisture.		Damaged kernels.		Foreign material other than dockage.		Wheat of othe classes.
	Class Hard Red Spring.	Classes Durum, Hard Red Winter, Common White, and White Club; and subclass Red Winter.	Subclass Red Walla.	Classes Hard Red Spring and Durum.	Classes Hard Red Winter, Soft Red Winter, Common White, and White Club.	Total.	Heat damage.	Total.	Matter other than cereal grains.	Total.
	Lbs.	*Lbs.*	*Lbs.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1	58	60	58	14.0	13.5	2	0.1	1	0.5	5
2	57	58	56	14.5	14.0	4	0.2	2	1.0	10
3	55	56	54	15.0	14.5	7	0.5	3	2.0	10
4	53	54	52	16.0	15.5	10	1.0	5	3.0	10
5	50	51	49	16.0	15.5	15	3.0	7	5.0	10
Sample*										

* *Sample grade.*—Shall be wheat of the appropriate subclass which does not come within the requirements of any of the grades from No. 1 to No. 5, inclusive, or which has any commercially objectionable foreign odor, except of smut, garlic, or wild onions, or is very sour, or is heating, hot, infested with live weevils or other insects injurious to stored grain, or is otherwise of distinctly low quality, or contains small, inseparable stones or cinders.

(1) The wheat in grade No. 1 shall be bright.

(2) The wheat in grades Nos. 1 to 4, inclusive, shall be cool and sweet.

(3) The wheat in grade No. 5 shall be cool, but may be musty or slightly sour.

(4) The wheat in grade No. 1 Dark Northern Spring and grade No. 1 Northern Spring may contain not more than 5 per centum of the hard red spring wheat variety Humpback.

(5) The wheat in grade No. 1 Amber Durum and grade No. 1 Durum may contain not more than 5 per centum of the durum wheat variety Red Durum.

(6) For each of the subclasses of the class Durum, grade No. 1 and grade No. 2 may contain not more than 2 per centum and 5 per centum, respectively, of soft red winter, common white, and white club wheat, either singly or in any combination.

(7) For each of the subclasses of the classes Hard Red Spring and Hard Red Winter, grade No. 1 and grade No. 2 may contain not more than 2 per centum and 5 per centum, respectively, of common white, white club, and durum wheat, either singly or in any combination.

(8) For each of the subclasses of the classes Soft Red Winter, Common White, and White Club, grade No. 1 and grade No. 2 may contain not more than 2 per centum and 3 per centum, respectively, of durum wheat.

NOTE.—For grades for Mixed wheat, Treated wheat, Garlicky wheat, and Smutty wheat see sections Nos. 21, 22, 23, and 24, respectively, of the official grain standards of the United States for wheat.

The above tabulation does not constitute in whole the official grain standards of the United States for wheat.

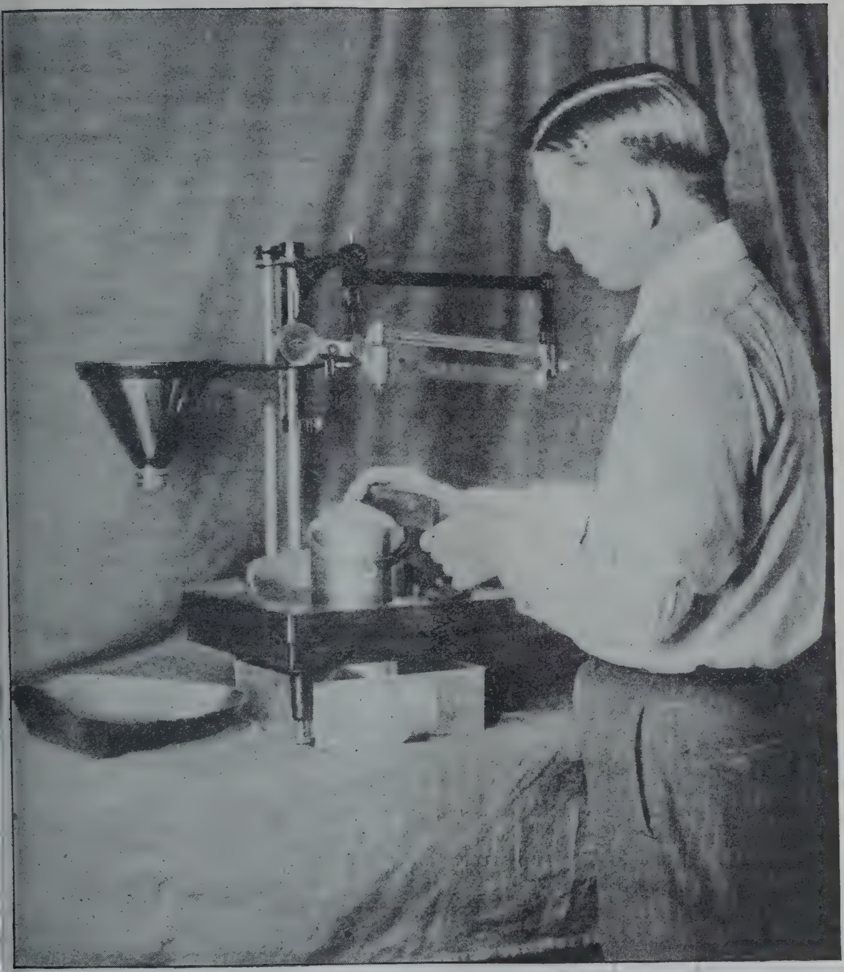


FIG. 10.—Standard method of determining the test weight per bushel.[1] The test weight per bushel is determined on the dockage-free wheat. The wheat is poured into the quart kettle from a funnel, the opening of which is 1¼ inches in diameter and 2 inches above the top of the kettle. The excess grain is stroked off by means of three zigzag motions with the sides of the special wood stroker, with round edges, held vertically.

---

[1] NOTE.—The quart tester shown in figure 10 is described in detail in U. S. Department of Agriculture Bulletin 472, together with the standard method of making the test. This tester has been adopted as the official tester and is being used by the department in connection with the enforcement of the United States grain standards Act. (The special stroker should be of hardwood, ⅜ inch thick, 1¾ inches broad, and 12 inches long, each edge being a perfect half circle.)

POST-OFFICE ADDRESSES OF OFFICES OF FEDERAL GRAIN SUPERVISION.

Atlanta, Ga.:
1712 Citizens and Southern Bank Bldg.
Baltimore, Md.:
610 Keyser Bldg.
Boston, Mass.:
Room 1140, 141 Milk St.
Buffalo, N. Y.:
98 Dun Bldg.
Cairo, Ill.:
Room 6, Postoffice Bldg.
Chicago, Ill.:
General Field Headquarters, 1132, 327 South La Salle St.
Chicago, Ill.:
District Supervisor's Office, 970, 208 South La Salle St.
Cincinnati, Ohio:
210 Johnston Bldg.
Cleveland, Ohio:
709 Illuminating Bldg.
Denver, Colo.:
509 Cooper Bldg.
Duluth, Minn.:
Rooms 1–4, Sherwood Bldg.
Fort Worth, Tex.:
511 First National Bank Bldg.
Galveston, Tex.:
222 Security Bldg.
Indianapolis, Ind.:
827 Board of Trade Bldg.
Kansas City, Mo.:
310 Postal Telegraph Bldg.
Louisville, Ky.:
27 Board of Trade Bldg.
Memphis, Tenn.:
403 Exchange Bldg.
Milwaukee, Wis.:
821 Railway Exchange Bldg.
Minneapolis, Minn.:
326 Flour Exchange.
Nashville, Tenn.:
807 Independent Life Bldg.
New Orleans, La.:
504 Pan-American Bank Bldg.
New York, N. Y.:
Room 1607, 27 William St.
Oklahoma City, Okla.:
502 Patterson Bldg.
Omaha, Nebr.:
738 Brandeis Bldg.
Peoria, Ill.:
509 Lehmann Bldg.
Philadelphia, Pa.:
578 Bourse Bldg.
Portland, Oreg.:
519 Postoffice Bldg.
San Francisco, Calif.:
1131 Merchants Exchange.
Seattle, Wash.:
2304 L. C. Smith Bldg.
Sioux City, Iowa:
335–338 Grain Exchange Bldg.
Spokane, Wash.:
516 Chamber of Commerce.
St. Joseph, Mo. (substation of Kansa City):
1008 Corby-Forsee Bldg.
St. Louis, Mo.:
817 Pierce Bldg.
Tacoma, Wash. (substation of Seattle)
138 Perkins Bldg.
Toledo, Ohio:
2009 Second National Bank Bldg.
Wichita, Kan.:
313 Sedgwick Bldg.

UNITED STATES DEPARTMENT OF AGRICULTURE

Farmers' Bulletin 1119
United States Department of Agriculture

ALL-SOWN OATS

FALL-SOWN grain crops in the South provide a winter cover for the land, thus preventing washing and leaching. They also provide winter pasture and grain and forage for work stock and may be grown to advantage in rotation with corn and cotton. The oat crop is one of the best for fall sowing where it withstands the winter.

The principal varieties of oats suitable for fall sowing are the Red Rustproof, Fulghum, and Winter Turf. The Red Rustproof and Fulghum should be grown in the Gulf States, Georgia, and the Carolinas, and the Winter Turf in Virginia, Tennessee, and Kentucky.

Fall oats should be sown on well-prepared land with a grain drill at the rate of 2 to 3 bushels to the acre. The date of seeding varies from September 15 to November 15, according to the locality. Only clean, plump seed should be sown.

Fall oats may be harvested with the binder or the mower. A large part of the crop is cut for hay or is fed in the bundle without thrashing. Bundle oats and oat hay make excellent summer feed for work stock. Oats may also be used for pasture or as a soiling crop.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. July, 1920

FALL-SOWN OATS.

W. WARBURTON, *Agronomist in Charge of Oat Investigations* and T. R. STANTON, *Assistant Agronomist, Office of Cereal Investigations.*

CONTENTS.

he fall-oat area 3
dvatages of fall over spring seeding 4
arieties of fall-sown oats 6
ils and fertilizers 9
  Soils adapted to oat production 9
  Manures and commercial fertilizers 11
all oats in the rotation 12
reparation of the land 13
Preparation of the seed 13
  Cleaning and grading 13
  Treatment of seed for smut 14
Sowing the seed 14
  Time of seeding 14
  Method of seeding 15
  Rate of seeding 16
Treatment of the land after seeding 17
Weeds 18
Harvesting the crop 18
Uses of the oat crop in the South 20

THE FALL-OAT AREA.

THE United States devotes more than 42,000,000 acres to oats each year, of which more than nine-tenths is spring sown. No regu-ar annual reports on the acreage of fall-sown oats are made by the ureau of Crop Estimates of the United States Department of Agri-ulture. However, this bureau made special reports on the acreage of all-sown oats for the years 1916, 1917, and 1918, the figures reported eing 3,054,000, 3,278,000, and 2,372,000 acres, respectively. The creage harvested, as compared with the acreage sown, was re-orted for 1917 only; of the 3,278,000 acres sown 2,424,000 were arvested. The difference between the seeded and harvested acre-ges normally is not so great, as the percentage of winterkilling uring the winter of 1916–17 was unusually high.

These special reports show that in the fall-oat area, embracing he States from Maryland, West Virginia, Kentucky, Arkansas, and klahoma southward, about 45 per cent of the oats grown are fall own. The States in which more than 60 per cent of the acreage sown in the fall are North Carolina, Georgia, Florida, Alabama, ississippi, and Louisiana.

Fall oats are much less hardy than fall wheat and rye and can e grown only where the winters are comparatively mild. No efinite limits can be drawn marking the sections where fall-sown ats succeed. The variety, the method of preparation, the time and anner of seeding, the kind of land on which the crop is grown, and the climatic conditions of the particular section must all be taken into account. Oats sown early in drills or furrows on well-prepared land often survive the winter in the same locality where those sown under less favorable conditions winterkill. Fall-sown oats may be successfully grown in a particular section for several years; a season may then come when the crop will be entirely destroyed by cold or other unfavorable conditions. This was the case in the winter of 1916–17, when February freezes killed oats in localities where they were supposed to be practically a certain crop.

The accompanying map (fig. 1) shows approximately the sections in which oats can be sown in the fall with a reasonable degree of success. The crop is recommended for South Carolina, Georgia, Alabama, Florida, Mississippi, and Louisiana; for Virginia and North Carolina, except in the Piedmont and mountain sections; and for southern and eastern Texas. In favorable years it can be grown in central and northern Texas, Arkansas (except the Ozark region), Tennessee, parts of Kentucky, at the lower elevations in western North Carolina and Virginia, and in southern Maryland. In these sections the yield is usually much better than that obtained from spring-sown oats; hence it is advisable to sow at least a part of the oat acreage in the fall and run the risk of loss from winterkilling. Fall-sown oats are also grown to a limited extent in western Washington and western Oregon. In California it is the practice to sow oats in the late fall or early winter. The conditions in these States are so different from those in the South, however, that discussion of them is not included in this bulletin.

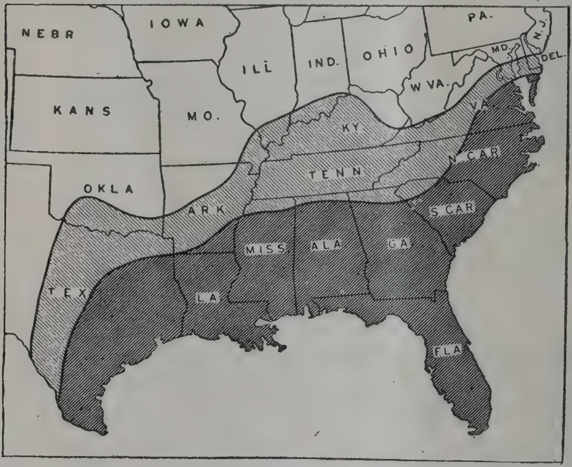


FIG. 1.—Map of the southeastern portion of the United States, showing the area in which oats may be sown in the fall. The heavily shaded portion shows the section where they are a comparatively sure crop; the section where they may be grown in favorable years in shown by lighter shading.

ADVANTAGES OF FALL OVER SPRING SEEDING.

Farm conditions in the South can be improved by the use of a greater variety of crops and of definite systems of crop rotation and by the keeping of a greater number of live stock. A rational crop rotation in the South is one which occupies the land practically the entire year, protecting the soil from washing during the winter by the use of a growing crop, such as crimson clover, vetch, or grain. Increasing the number of live stock requires the production of more grain for feeding. Fall-sown grains combine the two essential features, grain production and soil cover, in one crop. To some extent they also supply a third desirable feature, winter pasturage.

The advantages of fall seeding of oats over spring seeding wherever the fall-sown varieties can be grown are numerous. The yields are usually better, the fall-sown oats mature earlier, the land can usually be prepared in better shape in the fall than in the spring, fall seeding interferes less with other work than does spring seeding, poorer land and less fertilizer can be used for the fall-sown crop, and the fall-sown crop furnishes a cover for the soil during the winter and prevents washing.

Fall oats almost invariably yield more than spring oats, owing to their earlier maturity, stronger growth, and greater freedom from disease. If a part of the stand is lost from winterkilling, the plants which are left stool vigorously, so that the stand at harvest is often much better than was apparent in early spring. Fall-sown oats usually grow more vigorously and mature from 10 days to 2 weeks earlier than those sown in the spring. This earlier maturity often marks the difference between success and failure, as the later maturing grain is more likely to be injured by storms or drought and by rust and other plant diseases. Oats require comparatively cool weather for their best growth, so that those which mature earliest usually yield best, as the conditions are better suited to their development. The early maturity incident to fall seeding also allows the crop to be removed from the land earlier than spring seeding, giving more time for the preparation of the soil, seeding, and the growth of the following crop.

In order to obtain a satisfactory crop of spring oats it is necessary in the extreme South to sow the grain in January or early in February, and in February or early March farther north. At this time the ground is usually wet and cold and is not in condition to make a good seed bed. Clay soils may be materially injured by working them when wet, and only very sandy ones can be handled satisfactorily in this condition. On the other hand, at the time when the grain should be sown in the fall the ground is ordinarily in good condition to work, and a good, mellow seed bed can be prepared. This better preparation starts the young plants into vigorous growth and they go into winter in good shape. Seed sown in the winter or early spring on poorly prepared land is handicapped by this poor preparation, grows slowly, and is never as vigorous as that sown in a good seed bed.

When weather and soil conditions are right for preparing land in the spring, teams and men are needed to get the land ready for the more important crops, corn and cotton; consequently the preparation of the land for sowing oats is hurried or neglected. Fall seeding comes at a time when the teams are not needed for other work and there is more time to do the work properly. It allows a better division of the farm work, so that more time can be given to preparing the land in the spring for other crops. If the fall-sown crop of oats fails, little additional work is necessary to put the land in shape for reseeding in the spring.

As the plants have a longer time to draw the plant food from the soil and as they naturally grow more vigorously, fall-sown oats can be grown on poorer ground and with less fertilizer than those sown in the spring. Good soil and proper fertilization have much to do with the success of the oat crop in the South, however, regardless of the time of seeding.

One of the greatest losses on southern farms is from the washing of the soil during the winter. This can best be prevented by growing a fall-sown crop. Oats make a close, dense cover, which is very effective in holding the surface soil to prevent washing.

The foregoing are some of the reasons why it is desirable to sow oats in the fall in the South wherever there is a reasonable chance that they will withstand the winter. Proper methods of soil preparation and of seeding and the use of plump, heavy seed of hardy, productive varieties will largely increase the production of this grain. The methods described in this bulletin are in use by the agricultural experiment stations and by good farmers.

VARIETIES OF FALL-SOWN OATS.

The varieties of fall-sown oats commonly grown in the South are of two types, the Red Rustproof and the Winter Turf. The Red Rustproof type includes the common Red Rustproof under several similar names and selections and strains of that variety under entirely different names. Only one variety of the Winter Turf type is commonly grown, though many names are applied to it.

Red Rustproof is the typical variety of the group to which that name is here applied. Among the other names used for the same variety are Red, Texas Red, Red Texas, and Texas Red Rustproof. The leaves of the young plant in the fall are medium green in color and rather broad. The plant, while spreading, is less so than most other fall-sown grains. Seedling plants of the Red Rustproof oat are shown in figure 2. The straw of this variety is of medium height, straight and stiff. The heads are not large, but numerous. The grains are large and plump, yellowish or reddish brown in color, and usually all awned. The Red Rustproof is early in maturing and is quite free from rust. Varieties similar to the Red Rustproof, most of which are special strains of that variety which differ very slightly from it, are the Appler, Bancroft, Cook, Hundred-Bushel, McGehee, and Patterson.

The Fulghum oat has recently come into prominence in some sections, particularly where the Red Rustproof had been practically the only variety grown for decades. It was first grown extensively in southeastern Georgia, where it is believed to have originated. This new variety soon became widely distributed in adjoining States, and it is now second to the Red Rustproof in importance among fall-sown oats. It matures about 10 days earlier than the Red Rustproof and the grain is usually lighter in color. In the field the Fulghum can be readily distinguished from the Red Rustproof by its more erect heads or panicles. The kernels of the Fulghum also are smaller and are nearly free from the awns and basal hairs characteristic of that variety; consequently its bushel weight is usually higher. As it yields nearly or quite as well, its earliness gives it a distinct advantage. Panicles (heads) of the Red Rustproof and Fulghum varieties are shown in figure 3.

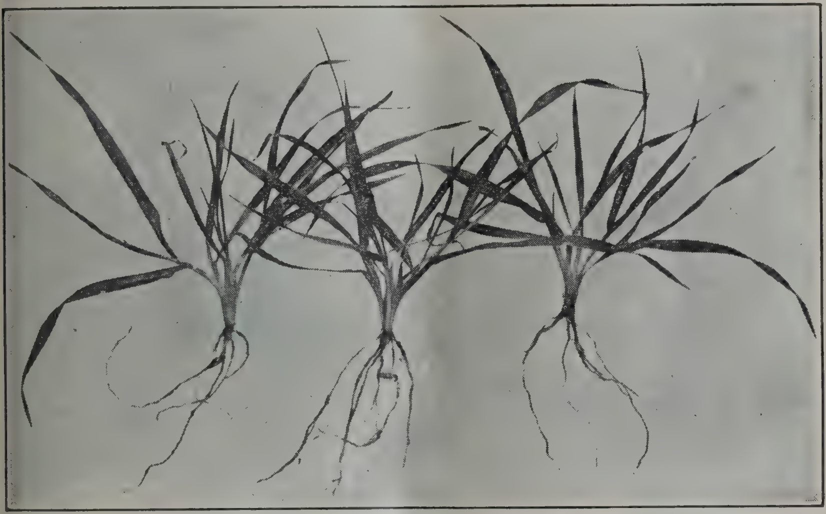


Fig. 2.—Seedling plants of the Red Rustproof oat. Note the partially erect habit as compared with the spreading habit of the hardier Winter Turf oat shown in figure 4.

Commercial lots of Red Rustproof oats often contain some medium-sized white kernels, producing strong plants and large heads which mature at about the same time as those from the red grains. The Culberson variety, as it is commonly grown, appears to be a selection of this white-kerneled type, though occasionally oats sold under this name can not be distinguished from the common Red

Rustproof. In some localities the Culberson oat yields as much grain as the Red Rustproof, produces more straw, and is a better variety to grow for hay or soiling. It is not at all commonly grown, however.

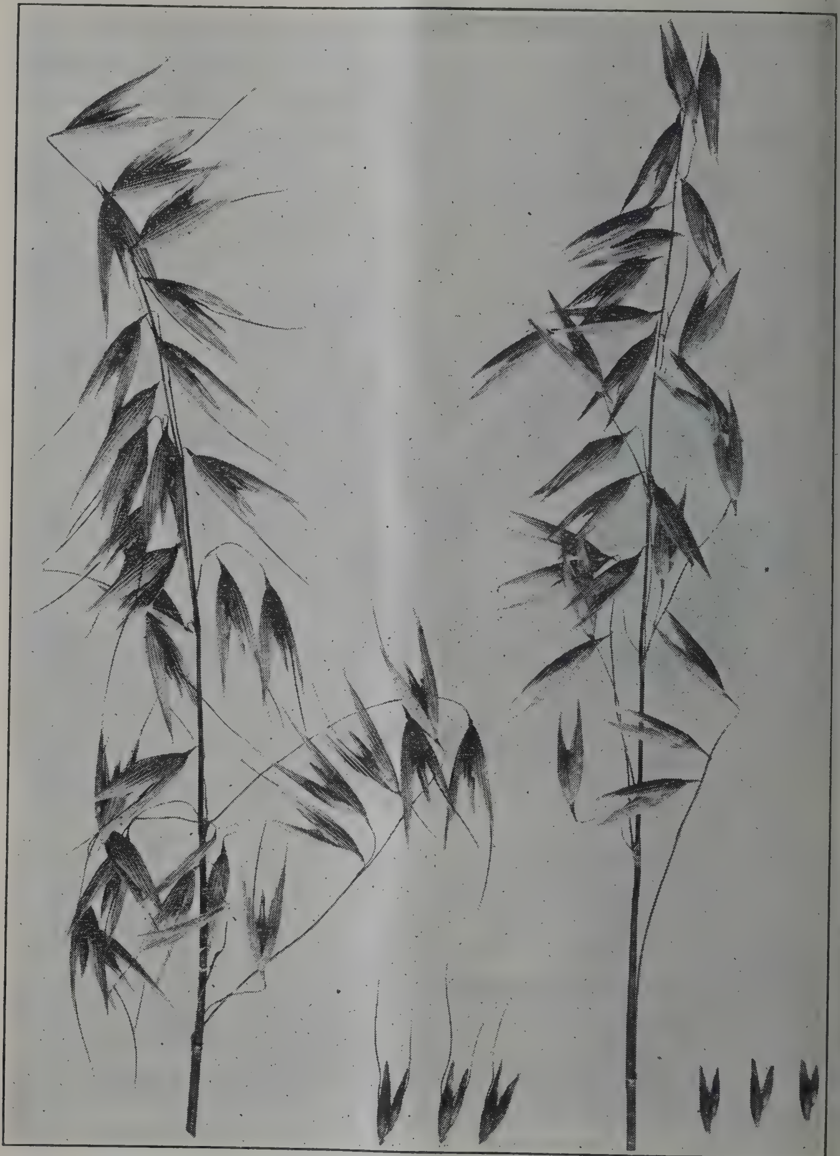
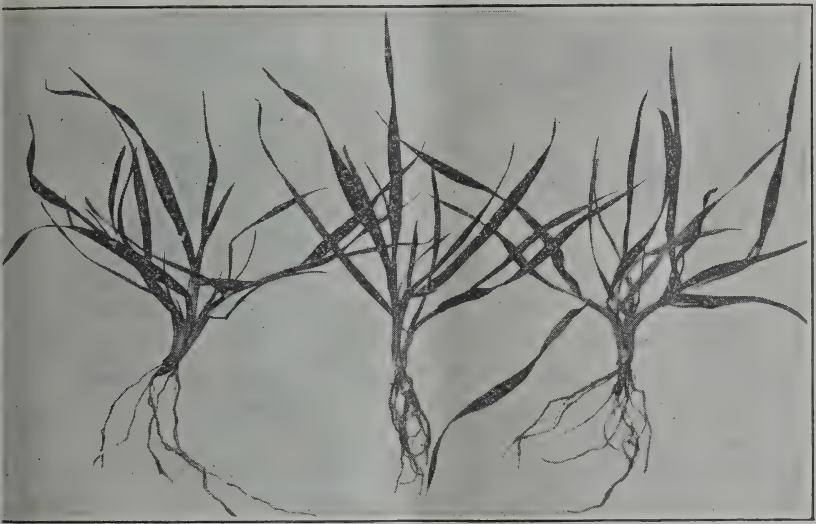


FIG. 3.—Heads of the two leading varieties of winter oats: Left, Red Rustproof; right, Fulghum.

The Winter Turf oat, which is also called Virginia Gray, Virginia Winter, Grazing, and several similar names, is better adapted to pasture and hay than to grain production. The leaves are narrow, ark green in color, and numerous; the plant is more spreading in e fall than that of the Red Rustproof variety. This is well shown y a comparison of figures 2 and 4. The straw is tall and slender nd the heads large and loose. The grain is of medium size, usually ght gray in color, with distinct darker lines running from the base the tip. The Winter Turf oat is either bearded or beardless; the eards, when they do occur, break off readily in thrashing. This ariety is not resistant to rust or lodging. The numerous names pplied to it may sometimes denote distinct strains, which, however, iffer but little from the type. Heads of the Winter Turf and ulberson varieties are shown in figure 5.



IG. 4.—Seedling plants of the Winter Turf oat. Note the spreading habit of growth, which denotes winter hardiness.

The varieties of the Red Rustproof type are best adapted to the roduction of grain in all except the coldest portions of the fall-oat elt, where Winter Turf is to be preferred on account of its greater ardiness. In the sections where the Red Rustproof is sufficiently ardy, the Winter Turf is rather too late in maturing and is often njured by hot weather, producing low yields of poor quality. For asture and hay production the Winter Turf is better than the Fulghum, Red Rustproof, or Culberson. Toward the northern limits of fall-oat production only the Winter Turf should be grown.

SOILS AND FERTILIZERS.

SOILS ADAPTED TO OAT PRODUCTION.

The soil for oats should be reasonably fertile and should hold moisture well, as this crop requires a large quantity of water and may be

severely injured by drought. Any soil which will grow a good cro
of cotton or corn will produce oats, though the best results will b

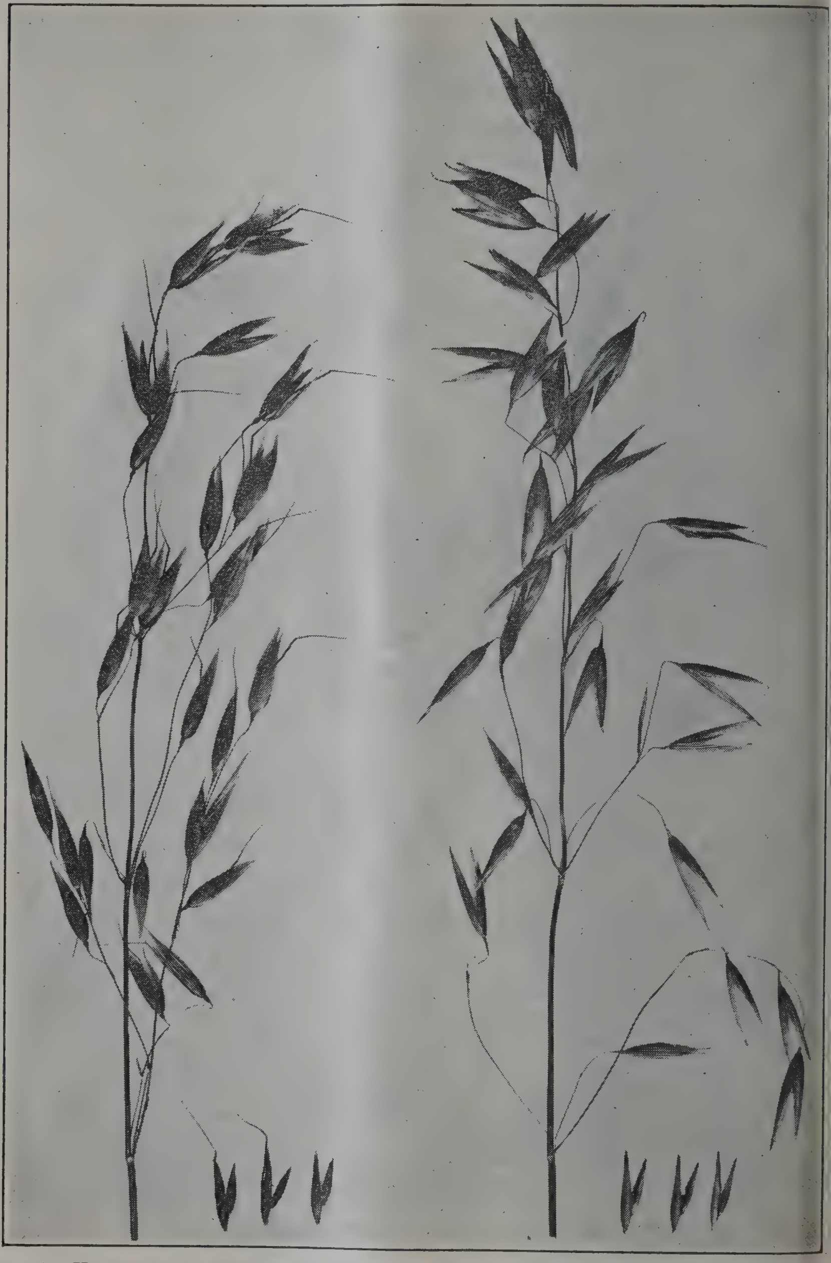


FIG. 5.—Heads of two less important varieties of winter oats: Left, Winter Turf; right
Culberson.

secured on the heavier loams. Heaving, or the "spewing out" of th
plants, is most likely to occur on clay soils, particularly on thos

eficient in humus. A well-fertilized sandy or sandy loam soil will enerally prove more satisfactory, particularly if it is well filled with umus, so that its moisture-holding capacity is high. Good drainage s essential, however, as winterkilling is most likely to occur on poorly drained land. Rust and other diseases are also most severe n low, poorly drained areas. As the varieties of oats commonly grown in the South, with the exception of the Winter Turf, have tiff straw, they are less likely to lodge on rich soil than those grown n the North.

MANURES AND COMMERCIAL FERTILIZERS.

The kind and quality of fertilizers to use for oats, as for other crops, depend largely on the nature and fertility of the soil, and consequently local practice is generally the best guide. Barnyard manure is not usually available in sufficient quantities in the South o be much of a factor, and therefore dependence must be placed on green manures and commercial fertilizers. The crop most commonly used for green manuring in the South is cowpeas, though crimson clover, vetch, velvet beans, bur clover, peanuts, and red clover are among those available. Cowpeas, soy beans, and velvet beans are among the best available crops to immediately precede oats. These crops may be cut for hay, turning under only the stubble and roots, or the entire crop may be used as green manure. The fertilizing effect on the following crop is about the same whether the stubble or the entire plant is turned under, but the vines add considerable humus and improve the physical condition of the soil. If the vines are turned under, the land should be plowed three or four weeks before the oats are to be sown, as the ground should have time to settle before seeding. If the oats must be sown at once after the land is prepared, it is better to harvest the vines and disk the land thoroughly instead of plowing it.

If the soil has been liberally fertilized for other crops, phosphoric acid and potash need not be added for oats. Usually, however, increased yields result from light applications of acid phosphate and muriate of potash at the time of seeding. The proper quantity of acid phosphate to apply varies from 100 to 125 pounds to the acre on fertile clay soils to 200 to 250 pounds on the poorer sandy soils. The rate for muriate of potash varies from 30 pounds on the better clay soils to 60 pounds on poor sandy ones. The price of this fertilizer during the past three or four years, however, has been too high to justify its use. Nitrogen is usually the limiting element in the production of oats on southern soils.

If nitrogen has been supplied in liberal quantities through the growth of legumes as green manures, it need not be added in commercial fertilizers. If, however, a green-manure crop does not immediately precede the oats, or if the preceding crop was light, some readily available fertilizer carrying nitrogen (ammonia) should be used. The best results on most classes of soil are to be obtained by adding this nitrogen as a top-dressing in the spring, about the time growth begins. On sandy soils, the application of about 25 pounds of nitrogen to the acre is recommended. This may be in the form of nitrate of soda, sulphate of ammonia, cottonseed meal, or dried blood. On clay soils this may be reduced to 18 or 20 pounds of nitrogen. If the oats are grown for hay, more nitrogen should be used than when they are grown for grain.

FALL OATS IN THE ROTATION.

Oats should follow a cultivated crop wherever possible. The most common cultivated crops in the South are cotton and corn, and, as corn is removed from the land earlier than cotton, oats usually follow the former. One of the best rotations which can be devised for the cotton-growing section is as follows: First year, cotton; second year, corn, with cowpeas planted at the last cultivation; third year, fall-sown oats, followed by cowpeas. The corn is cut for fodder, instead of being stripped and topped, as is commonly done in some sections; the corn stubble and cowpea vines are then turned under in time to sow oats in the fall. As the growth of pea vines is not heavy, the plowing can be done a short time before seeding. After the oat crop is removed the third year, the land is plowed and sown to cowpeas, which are cut for hay. If desired, crimson clover may be sown in the cotton the first year and plowed under in the spring before corn-planting time. Rye may also be sown the third year after the cowpeas and plowed under for cotton, thus providing a cover for the soil each winter. This rotation gives two grain crops, corn and oats; a money crop, cotton; a hay crop, cowpeas; and three green-manure crops, crimson clover, cowpeas planted in the corn, and rye, in three years. Two crops of cotton may be grown in this rotation, if desired, making a 4-year rotation.

Outside the cotton-growing section a good rotation, including oats, is as follows: First year, corn, with cowpeas in the corn; second year, oats, with clover or grass seeded in the oats; third year, meadow or pasture.

If it is desired to grow wheat, oats may be sown after the corn, and cowpeas may be sown after the oats are harvested. Wheat may then be sown after the cowpeas and grass seeded with it. Potatoes or other cultivated crops may be substituted for corn if desired. Where clover does not succeed, or where a permanent meadow is not wanted, the following rotation is a good one: First year, corn, with cowpeas in the corn; second year, wheat, followed by cowpeas to e cut for hay; third year, oats, followed by cowpeas, sorghum, or ome other forage crop. Rye may be sown after the forage crop is arvested, or the forage crop may be omitted and crimson clover own early in the fall. The rye or crimson clover is then plowed nder the following spring for corn. Other rotations along similar ines can be arranged, according to the crops it is desired to grow.

PREPARATION OF THE LAND.

The method of preparation of the land depends to some extent on he previous treatment it has received and on the character of the oil. In any case a seed bed with 2 or 3 inches of loose, mellow urface soil and a firm subsoil should be prepared, as the success of he crop depends in a large measure on the condition of the seed bed nd on the fall growth.

If the land has been thoroughly plowed for the preceding crop, isking is usually preferable to plowing for fall-sown oats, particuarly if the preceding crop was a cultivated one which has been ept free from weeds. Two diskings, lapping half, and a harrowng are usually sufficient, though more work may be necessary to nake a good seed bed on hard, dry soils.

If, for any reason, it seems desirable to plow the land, it should be lowed 5 or 6 inches deep at least a month before the oats are to be own and the plow followed immediately by a spike-tooth or other smoothing harrow. Double disking and another harrowing should then put it in shape for drilling. If it is loose from recent plowing, the roller or plank drag may be used to make a more compact seed bed. Rolling may often be done to advantage on loose, sandy land, but on the heavier loam and clay soils the roller should always be followed with the harrow, to break the crust and check evaporation. The fertilizer may be distributed when the seed is sown if the oats are to be drilled; otherwise it should be applied before the last harrowing.

PREPARATION OF THE SEED.

CLEANING AND GRADING.

The yield of oats can be considerably increased by cleaning and grading the seed and by treating it to prevent smut.

Seed oats should be thoroughly cleaned and graded before sowing. The stand produced from heavy seed is better and more uniform than that from ungraded seed. The strong, vigorous plants produced from plump, heavy seed stand the winter better than the weak ones which grow from light shriveled grains; their growth is better throughout the season and the yield larger. Cleaning the seed not only removes the weak, light grains of oats but takes out many weed seeds. Most of the seeds of cheat, or chess, one of the most troubl some weeds in oat fields, can be removed by thorough cleaning.

Seed oats are usually cleaned and graded with the fanning mil but where this machine is not available and the quantity of see sown is small, fairly effective work can be done by pouring the grai back and forth from one vessel to another in a brisk wind. If considerable quantity of seed is to be cleaned, the gain from sowin cleaned seed will soon repay the cost of a fanning mill.

TREATMENT OF SEED FOR SMUT.

A considerable portion of the oat crop is lost each year from th attacks of the smut fungus. This loss is easily and cheaply prevente by treating the seed before sowing with a solution of 1 pound o commercial formaldehyde (a solution of 37 to 40 per cent of pur formaldehyde) to 40 gallons of water.[1]

The grain should be placed on a clean floor or canvas and sprinkle with the solution. The pile should be shoveled over continuousl while applying the formaldehyde, to make sure that all the grain i thoroughly moistened. It should then be covered with blankets o canvas and left for several hours or over night, when it may be sow at once or spread out to dry. It will run through the drill much better if dried before sowing. Grain may also be treated by pouring i into a tub of the solution, stirring thoroughly, and spreading out t dry after it has remained in the solution 20 minutes to 2 hour Sprinkling is just as effective, however, and is a cheaper and mor rapid method. Care should be used not to put the treated grain int bins, sacks, or machinery where it is likely to come in contact wit smut spores.

SOWING THE SEED.

The success of the fall oat crop depends in a large measure on th time, the rate, and the manner of seeding. Early seeding with th grain drill or in open furrows, using 2 to 3 bushels of seed to th acre, is recommended.

TIME OF SEEDING.

Fall-sown oats are less hardy than wheat or barley and for tha reason should be sown earlier, so that the plants may become wel rooted and make considerable top growth before cold weather. Oat are seldom attacked by insects in the fall, so that there is no necessit for delay in seeding, as with wheat where the Hessian fly is common In the extreme South, seeding need not be done until November, bu farther north September and October are the best months.

---

[1] Farmers' Bulletin 939, entitled "Cereal Smuts and the Disinfection of Seed Grain,' gives complete directions for the use of the formaldehyde treatment.

In Oklahoma, northern Arkansas, Kentucky, Tennessee, Maryland, nd the higher portions of Virginia and North Carolina seeding ould usually be completed by September 20. In the lower porons of Tennessee, Virginia, and North Carolina, the mountain secons of South Carolina, Georgia, and Alabama, southern Arkansas, nd in northern Mississippi and Texas, the seed should ordinarily e sown between September 20 and October 10. In northern Louisina, central Texas, Mississippi, Alabama, and Georgia, and the wer portion of South Carolina seeding may be done almost any me during the month of October, while along the Gulf coast late ctober and early November seeding is usually satisfactory.

METHOD OF SEEDING.

The methods of seeding oats are (1) broadcast seeding; (2) drillng with the ordinary grain drill; and (3) drilling with a specially evised drill by what is known as the open-furrow method.

Oats are sometimes sown broadcast, but this method is not to be ecommended. When sown broadcast and harrowed in, much of the eed is left near the surface, even in well-prepared ground, so that any of the plants are shallow rooted and are killed by heaving or old. A better method, where broadcast seeding is necessary, is to ow the seed on clean ground which has been disked, covering it bout 3 inches deep with the turning plow. The ground should then e left rather rough, as the uneven surface furnishes some protection or the plants. More seed should be used in broadcast seeding than n drilling.

The use of the grain drill in sowing oats is strongly recomended. Drilling produces a more uniform stand and more even ermination and growth than broadcast seeding. Drilling also reuires less seed and the plants are less likely to winterkill. Drilling t least 3 inches deep on well-prepared land, leaving the drill furows as open as possible, is advised. Drag chains should not be sed on the drill, nor should the land be harrowed after drilling. his leaves the seed in the bottom of shallow furrows, which in a easure protects the young plants from winterkilling. Figure 6 hows a disk drill as it should be used in sowing oats in the fall.

As the kernels of varieties of the Red Rustproof type are likely to tick together, the drill should be watched closely to see that the eed is being evenly distributed. A drill with a good force feed will ow this variety quite satisfactorily.

The Georgia experiment station a number of years ago devised hat is known as the open-furrow method of seeding oats. By this ethod the seed is sown in drills from 16 to 24 inches apart, the ordiary single-row planter or a specially devised drill being used for he purpose. If desired, a drill with a fertilizer attachment may be used and the fertilizer distributed in the furrows with the seed. A combined grain and fertilizer drill, for sowing four rows 16 inches apart by the open-furrow method, is shown in figure 7. The seed is sown in drills or furrows several inches deep, so that the roots and crowns of the plants are 2 or 3 inches below the surface. The rains and alternate freezing and thawing partially fill these furrows, but the plants are still left well below the surface. While this method has been strongly recommended by some writers, experiments indicate that ordinarily no increase in yield is obtained from its use.

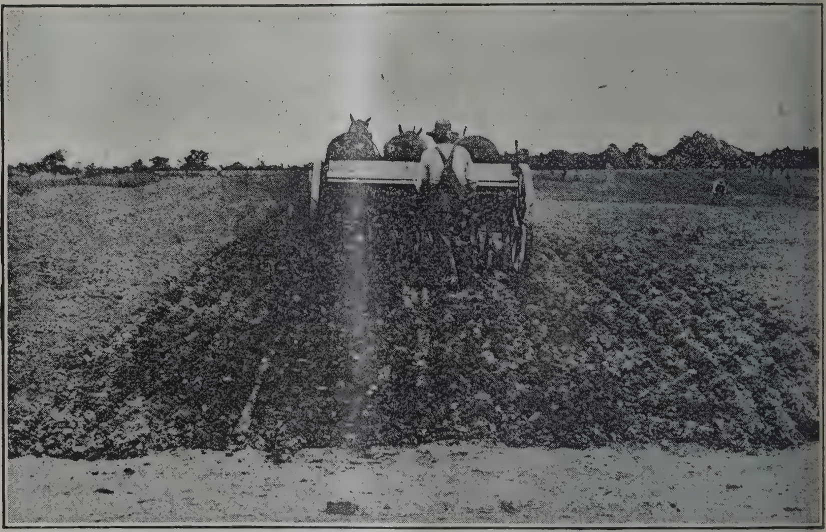


FIG. 6.—A disk drill with drag chains removed, as it should be used in sowing oats in the fall.

RATE OF SEEDING.

The rate of seeding usually recommended for Red Rustproof and similar varieties of oats when sown with the open-furrow drill is 2 bushels to the acre. When sown with the ordinary drill 2½ bushels is about the proper rate. Broadcast seeding requires still more seed from 3 to 4 bushels being necessary. As the Winter Turf oat is somewhat hardier and stools more than the Red Rustproof, it may be seeded at a lower rate, from 1½ to 2 bushels when drilled or 2½ bushels when sown broadcast. In the northern portion of the fall-oat area, where the danger from winterkilling is great, and farther south when late seeding is necessary, the rate of seeding should be somewhat increased.

From 2½ to 3 bushels of the Red Rustproof or Culberson and 2 to 2½ bushels of the Winter Turf are about the proper rates of seeding for the colder portions of the fall-oat belt. When the crop is to used for pasture or hay somewhat heavier seeding is advisable an where it is grown for grain. When used as a nurse crop for asses or clover or when grown with crimson clover or vetch, less ed should be used than when oats are grown alone.

TREATMENT OF THE LAND AFTER SEEDING.

Top-dressing with barnyard manure in the fall and the applica- on of nitrate of soda in the spring have already been mentioned means of increasing the yield of fall-sown oats. In- ry to the plants from heaving during the winter and rly spring, with the consequent exposure of the roots the sun and wind, may sometimes be prevented by lling the land as soon as possible after the heaving kes place. Clay soils, the type on which heaving is most likely occur, should not be rolled when wet, so that this method of ducing the damage can not always be used. When the open- rrow method of seeding is used the ridges between the rows should leveled down in the spring with a harrow.

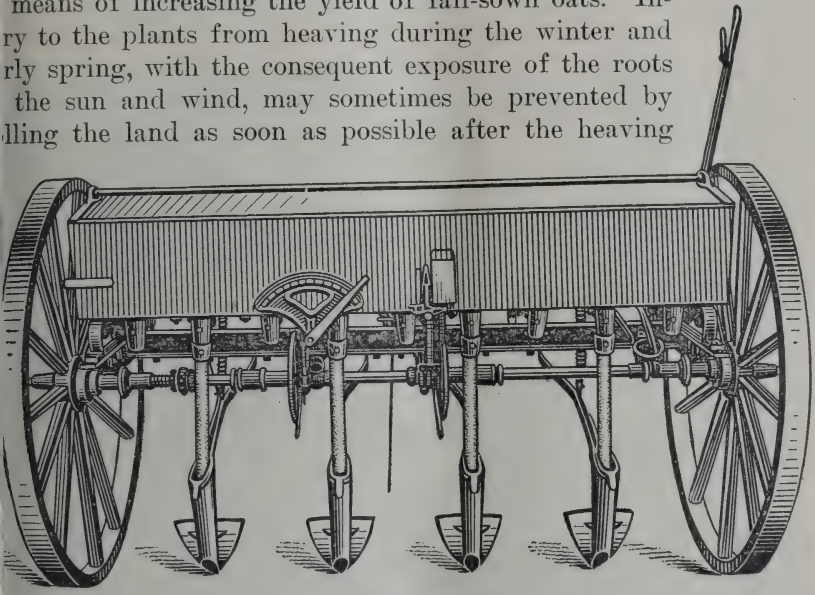


Fig. 7.—Open-furrow drill for sowing oats in the fall.

Oats, like other fall-sown grains, are sometimes used as pas- re for stock. Early seeding is particularly essential when the op is to be pastured in the fall. Pasturing at this time always creases the danger from winterkilling, as it lessens the protection fforded by the leaves. Fall-sown oats should not be pastured as osely as wheat or rye, as the oats are less hardy than the other rains. Pasturing in the spring delays maturity. As earliness is ssential to the production of a good crop of oats the value of the asture does not usually make up for the loss in yield of grain. rain fields should never be pastured when the ground is wet, as the rampling injures the physical condition of the soil and many of e grain plants may be pulled out.

WEEDS.

One of the most common weeds in fall-sown oat fields is cheat, c chess. The popular belief that oats turn to cheat is due to the rapi vigorous growth of this weed and the manner in which it occupie the ground where grain has winterkilled. Occasional plants of chea which would hardly be noticed in a good stand of oats, grow so vi orously and stool so abundantly when given plenty of space by th winterkilling of the oats as to give the impression that the enti crop has turned to cheat. When a considerable proportion of th crop is cheat, the best plan is to cut the oats and cheat together f hay before the seeds mature. If the oats are entirely killed th cheat should be plowed under and the land used for a cultivated cro Other winter weeds, such as chickweed, shepherd's-purse, and pe pergrass, sometimes cause trouble, but these are not often seriou pests and can usually be kept in check by harrowing. Weeds whi do not start growth until spring do not often cause trouble, as th growth of the crop is rapid at that season. Rotation of crops, goo cultivation, and thorough cleaning of seed grain are strongly reco mended as means of keeping weeds under control.

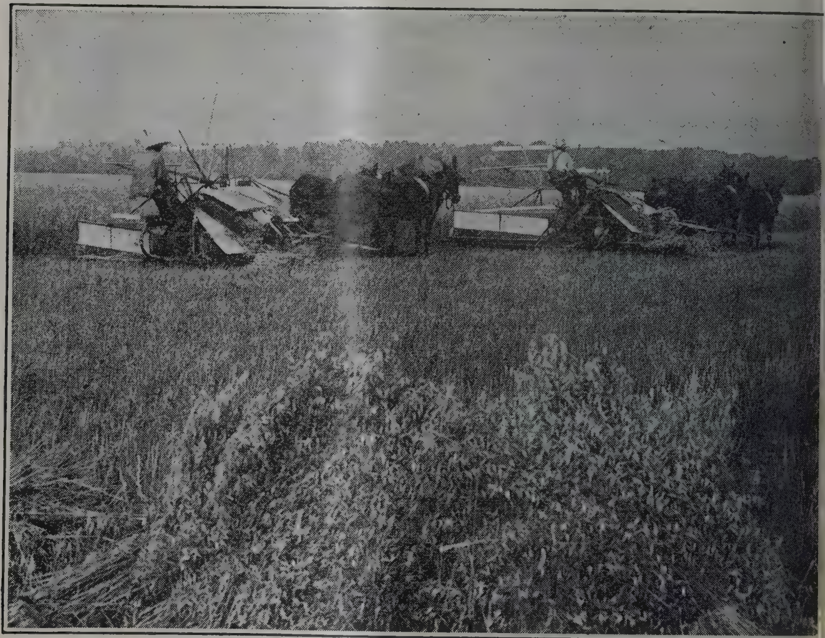


FIG. 8.—Harvesting fall-sown oats in Madison County, Miss.

HARVESTING THE CROP.

Oats are usually cut with a grain binder, but where the area is to small to justify the use of this machine, a mower or even a crad ay be used. If cut with the binder the grain should be allowed to and until nearly ripe or until just after it passes out of the hard ugh stage. Binders at work in a field of fall-sown oats are shown figure 8. The bundles or sheaves should be set up in round shocks 10 or 12 bundles each, using 1 or 2 bundles for caps or covering th canvas shock covers. The bundles should be thoroughly dry hen shocked and the shocks should be carefully built, so that the ain is exposed as little as possible to the weather. A field of fall-wn oats in shock in Mississippi is shown in figure 9. If it is neces-ry to cut the oats with a mower, they should not be as ripe as for nding, or there will be loss from shattering in handling. The ts usually grown in the South do not shatter readily, however. hen cut with the mower the grain should be allowed to cure for a ort time in the swath or windrow and should then be placed in ell-built cocks and, if possible, covered with canvas covers.

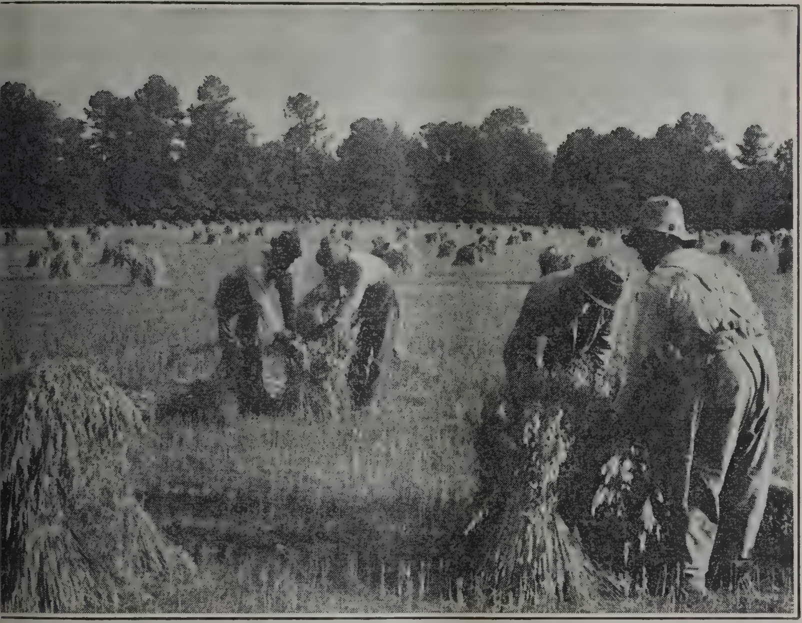


FIG. 9.—Field of Red Rustproof oats in shock, Madison County, Miss. Well built shocks help to protect the grain from injury by weather.

When the grain has cured in the shock, which will be in about ten ays if the weather is good, it should be stacked or placed under ver. If a thrashing machine is available, it may be thrashed at ace. In any case, it should be dry when stacked or stored, as it is kely to mold if at all damp. Grain which has been cut with the ower may be stacked as soon as cured and may then be handled the same manner as that which is bound. In either case, it ay, with little loss, be fed to stock without thrashing, or it may be thrashed when thoroughly dry. If it is thrashed, the grower shoul see that all the grain is removed from the straw and that the separ tion of grain and chaff is complete. After thrashing, the grai should be stored in tight bins, where it is protected from the weath and from vermin. The straw should be run into the barn or car fully stacked, so that the loss from weathering will be slight.

If the crop is to be used for hay, it should be cut after the grai is developed but before the straw becomes tough and hard. If is grown with vetch, crimson clover, or some other crop, the tin at which it is cut will depend to some extent on the state of maturit of the crop with which it is grown. The hay should be cured i the windrow and cock, with as little exposure to rain as possibl and should be placed under cover or stacked as soon as it is cure The curing of hay is sometimes difficult in the South, owing frequent rains, and the best quality can be secured only by protectin the cocks from the weather by the use of canvas covers. If these a carefully stored when not in use, they will last for a number of yea and will prove a good investment. Oats may be cut for soilin (feeding green) as soon as the heads begin to show, and cutting ma continue until the crop is nearly ripe. If cut in the early stages, th stubble will produce a fairly heavy second crop.

USES OF THE OAT CROP IN THE SOUTH.

The high value of oats for feeding to horses and mules is general well understood. The market price of oats in the South is usually high that this grain can not be fed with profit to any other class animals. Even when fed to horses and mules the most economic results can be obtained by substituting corn for a part of the ratio Oats are particularly valuable for feeding to colts and to oth young and growing stock. The value of this grain for feeding young animals is due to its high proportion of ash, or bone-formin material, and of protein, or muscle-forming material.

A very common practice in the South is to feed oats in the bund to work stock. The Red Rustproof and other southern varieti are unlike northern spring oats in that the leaves and stems are sti quite green when the grain is nearly ripe; hence the straw is muc better feed. Feeding oats in the bundle provides both grain ar hay for the animals and saves the expense of thrashing and providing tight bins for storing the grain. Bundle oats make excellent summer feed for horses and mules.

When oats are not too high in price they are a valuable grain f feeding to dairy cows, sheep, and poultry. As they are not fa producing, they are not of value in fattening cattle, while their hig proportion of crude fiber makes oats an inferior feed for hogs. Oa e usually fed whole to all kinds of stock, though for young animals for older ones with poor teeth the grain should be crushed.

Oat straw, as previously stated, is a better feed than the straw of y other small grain. It is a valuable roughage for feeding to all nds of stock not at hard work, but contains too much waste mateal to make up the entire ration. When fed with cowpea or other y which is high in feeding value it gives bulk to the ration and sens its cost.

Oats make excellent hay, which matures early enough in the sean to allow the production of another crop on the land. The yield heavy, from 1 to 3 tons to the acre, according to the fertility of the il, and the quality is high. The hay is easily cured and is relished all kinds of stock. The yield and feeding value may both be ineased by growing vetch or some other leguminous crop with the ts.

Good pasture for stock of all kinds is produced by fall-sown oats. s previously stated, however, pasturing the crop usually reduces e yield of grain. When the pasture provided by a fall-grain op is an important item it is usually better to use wheat or rye, as her of these crops may be pastured quite closely and yet produce satisfactory crop of grain. If desired, oats may be pastured closely the spring, then plowed under and the land planted at once to me other crop. Vetch and oats together make good pasture, parularly for sheep and hogs.

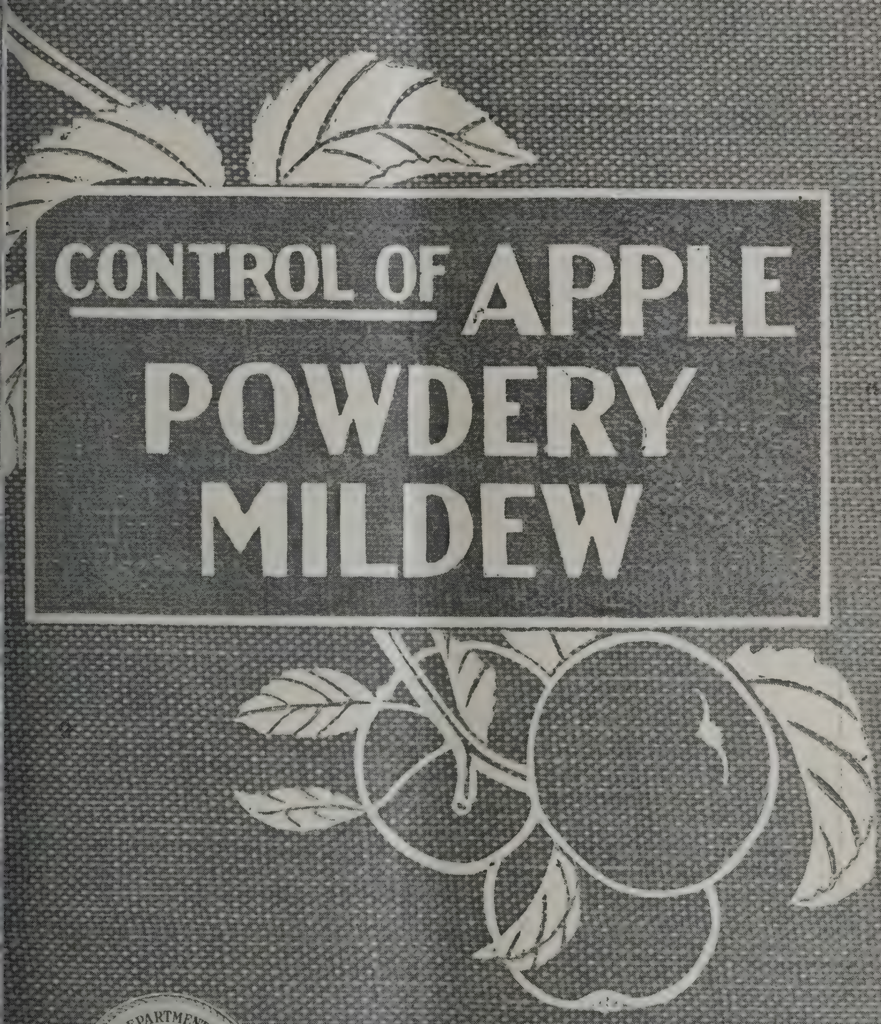
As a soiling crop oats can not be used as early in the spring as rye, t the feed produced is of better quality and can be used for a nger period. The quantity of green feed produced by oats is large, d the crop can be used over a considerable period. If cut early, good second crop is produced. Cutting can be begun as soon as the ants begin to show heads and may be continued until the grain is arly ripe. Green oats are relished by all kinds of stock, and there little waste in feeding. Vetch or crimson clover, grown with the ts, improves the quality of the green feed produced.

Oats are also used as a nurse crop and as a cover crop. The use of ts as a nurse crop is rather rare in the South, as grass or legumious crops are not often sown for the production of permanent eadows. In general, these crops succeed better in the South when eded without a nurse crop. Where a nurse crop is used, wheat and rley are to be preferred to oats, as they make less shade. As a inter cover crop, to prevent washing of the soil, the value of oats s already been stated.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

FARMERS' BULLETIN 1120
UNITED STATES DEPARTMENT OF AGRICULTURE

CONTROL OF APPLE POWDERY MILDEW



APPLE POWDERY MILDEW is a serious disease of nursery stock throughout the United States, and occasionally is serious on orchard trees in the East. In the apple-growing districts west of the Rocky Mountains, however, and especially in the Pacific Coast States, it has become an important orchard disease that annually causes heavy losses.

It is caused by a fungus that lives through the winter within the dormant buds and infects the new leaves, tender twigs, blossoms, and fruit in the spring.

Pruning out infected shoots during the dormant season is an important step in control, but this treatment must be supplemented by spraying during the growing season. The most effective sprays are diluted lime-sulphur solutions and those containing sulphur in a finely divided form.

This bulletin tells how to prepare the spray materials needed and how to apply them. A spraying schedule, showing concisely when and with what to spray, is included.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. May, 1920

CONTROL OF APPLE POWDERY MILDEW.[1]

D. F. FISHER,
Pathologist, Fruit-Disease Investigations.

CONTENTS.

	Page.
Economic importance of apple powdery mildew	3
Description of the disease	4
Cause of the disease	6
Control measures	7
Pruning	7
Control measures—Continued.	
Spraying	8
Technic of spraying	9
Time of spraying	10
Spray materials	12
Spraying schedule	13

ECONOMIC IMPORTANCE OF APPLE POWDERY MILDEW.

APPLE POWDERY MILDEW has long been recognized as a serious disease of nursery stock, but it was not until the development of an extensive apple-growing industry in the irrigated regions west of the Rocky Mountains that it attracted attention as an important orchard disease. It has been severe occasionally on old trees in the East, but in the important apple-growing districts of the Pacific Coast States it has become established and annually causes a heavy loss.

The disease frequently stunts the fruit and produces a disfiguring russeted appearance that greatly detracts from its market value. The chief loss, however, results from its attacks upon the foliage, which, in severe cases, so devitalizes the tree that it fails to produce fruit buds and causes a crop failure in the succeeding season.

The prevalence and severity of the disease in any season vary with the climatic conditions. When humid conditions prevail the spread of the disease is greatly facilitated, and it often assumes, if unchecked, epidemic proportions where it has become established. It is usually more common in the spring than during the summer, on account of the greater prevalence of rainy weather.

The disease is most important upon the apple, but also occurs on the pear, quince, hawthorn, cherry, plum, and juneberry. The commercial varieties of apple most susceptible to the disease are the Jonathan, Yellow Bellflower, Yellow Newtown, Esopus (*Spitzenberg*), Black Ben (*Black Ben Davis*), Grimes, and Rome Beauty. No variety is entirely immune, but the White Pearmain is the least susceptible and the Winesap is also resistant.

---

[1] This bulletin is of special interest to apple growers located west of the Rocky Mountains.

DESCRIPTION OF THE DISEASE.

The disease is found on the foliage, twigs, blossoms, and fruit of the apple.

Upon the affected leaves the disease is first manifested in small grayish or white feltlike patches of fungous growth. It usually appears first upon the under side of the leaves, which soon become crinkled and curled. When very young leaves are attacked they have a tendency to increase in length but not in breadth and may become somewhat folded longitudinally (fig. 1). The fungous patches rapidly enlarge and soon cover the entire leaf. In a very short time the affected areas are covered with masses of powdery spores, which give the disease its name and spread it about during the growing season. The affected foliage is rendered hard and brittle and is frequently killed. In any case it ceases to function normally, and a devitalization of the tree with consequent crop reduction results, the severity of which depends upon the proportion of the leaves attacked.

The tender twig growth may be infected independently, but is frequently attacked by the fungus spreading from attached leaves. Spores are produced on such twigs the same as on the leaves, and in addition another type, the ascospore, or winter spore, is produced upon the twigs. These winter spores are contained in the tiny globular black bodies that produce a speckled appearance in the felty fungous covering of affected twigs as early as the middle of June (fig. 2). The winter spores are no longer important in carrying the disease over winter, since the fungous threads penetrate and remain in the new buds which form on affected twigs. In the spring, when these infected buds open, the fungus resumes activity. The infection of twigs results in stunting or killing the parts affected, especially the terminal growth, which is particularly susceptible.

Blossom infection usually results from the overwintering of the fungus in the dormant blossom bud. In this case the entire blossom cluster, with attendant leaves, is attacked. The floral parts are shriveled and blighted, so that no fruit is produced (fig. 3). On account of the fact that infected buds do not open and spread mildew spores until some time after healthy buds have unfolded (usually about the time normal blossoms are dropping their petals), there is little danger of a general "blight" spreading over the blossoms during the blooming period.

The young fruits, however, are frequently attacked shortly after the blossoming period, and infections may remain established on the apples until the skin hardens in midsummer, after which the fungus generally does not persist upon the fruit. The fungus may become established upon the apples either by spore germination upon the fruit or by spreading down the stem from infected twigs. In the former case it is usually the calyx end of the apple that is affected, but in the latter the basin alone may be involved. When very young apples are infected their growth is stunted, but a russeting of the skin always results from the presence of the fungus (fig. 4). This

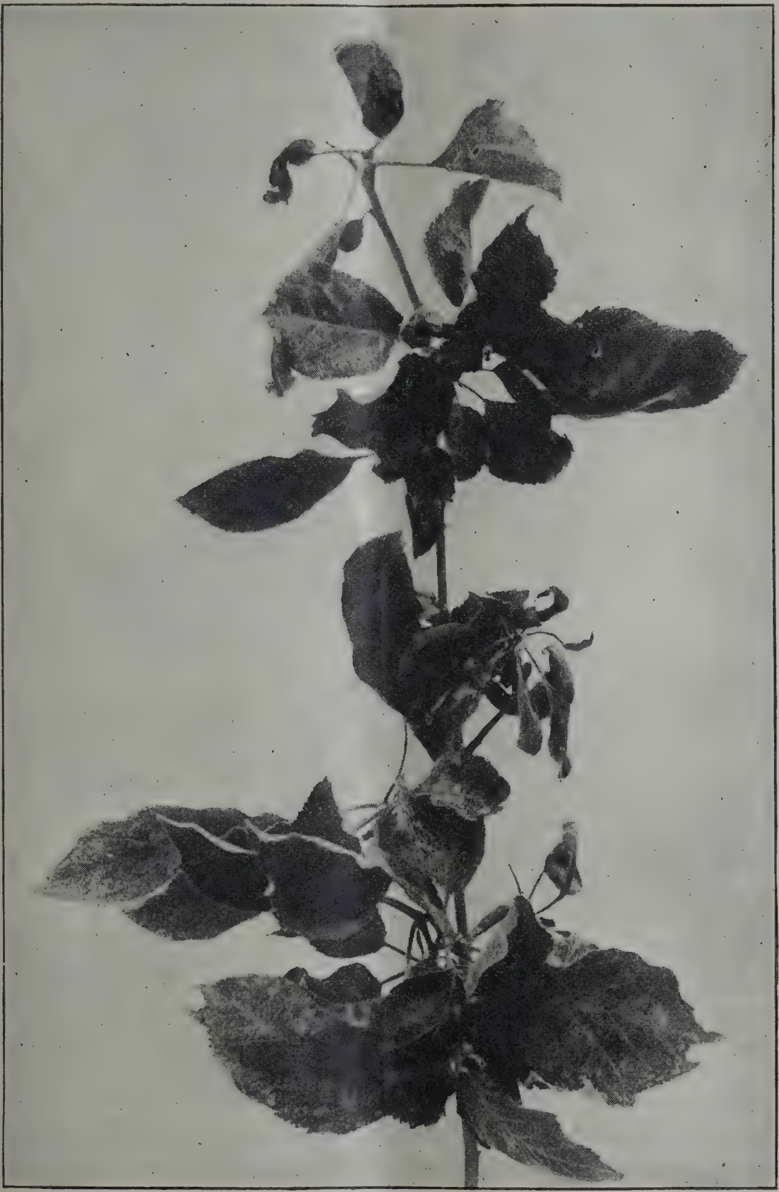


FIG. 1.—Branch of a Jonathan apple tree, showing three mildewed spurs. Note the curling and folding of the infected leaves on the central spur.

russeting shows a tracery of fine lines, usually as a network, but sometimes so closely woven that a solid patch appears. The expansion of the growing fruit frequently causes cracks to form in the hardened area and allows the apple to become shriveled (fig. 5).

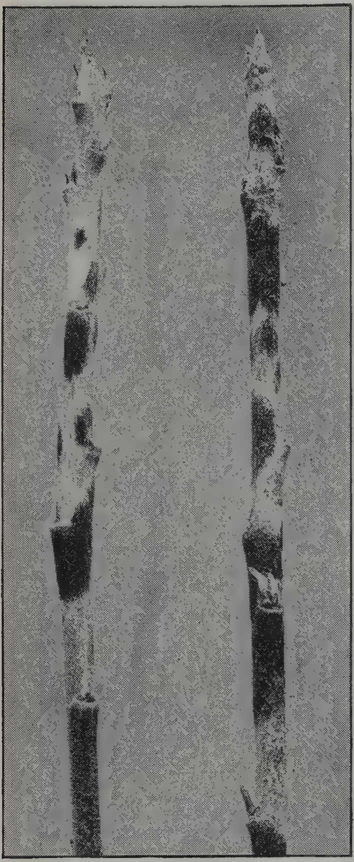


FIG. 2.—Mildew on dormant terminal shoots. Note the black patches of winter spores in the white fungous coating. The infected twig growth should be removed in the winter pruning, to assist in later control by spraying during the growing season.

CAUSE OF THE DISEASE.

Apple powdery mildew is caused by a fungus[1] which grows superficially upon the leaves, tender twigs, blossoms, and fruit of the apple. The feltlike covering of fungous threads over these parts sends down at frequent intervals tiny "suckers" to invade the cells of the host. These "suckers" extract the apple juices for the sustenance of the fungus. To propagate itself the fungus produces masses of spores in great profusion. These are wafted about by the wind. If one lodges upon tender growth where necessary moisture is present it will proceed to germinate and start a new infection.

This fungus has a very low moisture requirement for spore germination and therefore has adapted itself to growth in arid climates where other fungous diseases of the apple have not been able to persist. The occasional light rains in the spring are sufficient to give it a start, and the prevalence of dews during the growing season provides adequate moisture for it to continue to spread. With the increasing use of irrigation water and the increasing amount of transpiration from vegetation grown under irrigation the humidity of the air in these orchards has been increased. This, combined with the marked diurnal variation in temperature which characterizes such climates, brings dews nearly every night during the summer, and consequently conditions for the spread of mildew are becoming more favorable.

---

[1] *Podosphaera leucotricha* (E. and E.) Salm. *Podosphaera oxyacanthae* (DeC.) DeBary, a closely related organism, is occasionally found upon the apple in some parts of the eastern United States and produces effects very similar to *P. leucotricha,* but the latter is very much more prevalent, and it alone appears to be important as an apple disease.

CONTROL MEASURES.

Where it is necessary to spray for apple scab and where lime-sulphur or other sulphur sprays are used for this purpose, the scab treatment generally suffices for mildew control. Throughout the range of apple scab, therefore, mildew seldom requires special treatment. But in other localities, especially in arid regions, mildew must be treated independently.

Powdery mildew has been under investigation and experimental work on control measures has been carried on in such districts by the Office of Fruit-Disease Investigations since 1907. The recommendations for control made in this bulletin are based upon this work. During the early part of this period of investigation the work was carried on in the Pajaro Valley, Calif., where peculiar local conditions make the disease a most serious menace to the apple-growing industry and where local climatic influences necessitate special treatment to effect control.[1] Later work was carried on in the Wenatchee Valley, Wash., which is typical of the hot interior regions, where apple growing under irrigation has developed so extensively in recent years and where mildew control has become an important factor in successful orcharding.[2]

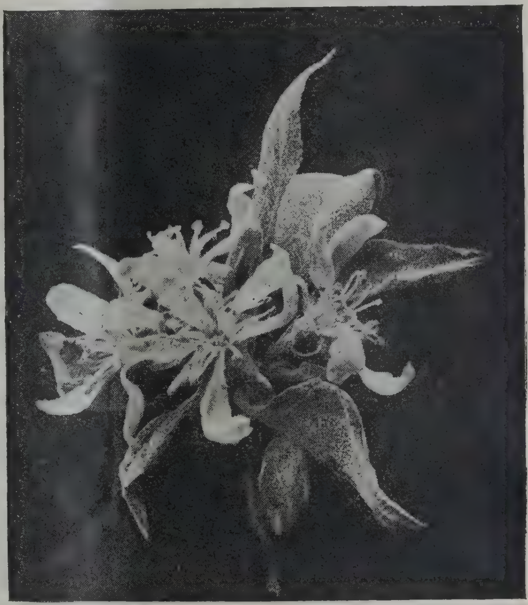


FIG. 3.—Mildewed blossom cluster from a Black Ben tree. Note the abundance of powdery spore masses over the leaves and blossoms and the deformity of the blossoms. Mildewed blossoms fail to produce fruit.

PRUNING.

In both of these investigations it was found important to remove the mildewed twigs in the winter pruning, thus eliminating sources of hold-over infection in the dormant buds and rendering much easier the control by spraying during the growing season. Mildewed shoo are easily detected during the dormant season by their gray silvered appearance. Isolated infections which exist in scatter buds, however, make it im possible to control the disea by pruning alone. Cuttin off infected shoots durin the growing season and burn ing the prunings are also help in establishing contro but in doing so spores a scattered and may spread th disease unless the trees a coated with a protecti spray.

---

[1] Ballard, W. S., and Volck, W. H. Apple powdery mildew and its control in the Pajaro Valley. U. S. Dept. Agr. Bul. 120, p. 26. 1914. Apple growers in regions of rainless, cool, and cloudy summers, but where ocean fogs frequently prevail are referred to this bulletin for control measures adapted to these peculiar conditions.

[2] Fisher, D. F. Apple powdery mildew and its control in the arid regions of the Pacific Northwest. U. S. Dept. Agr. Bul. 712, p. 28. 1918.

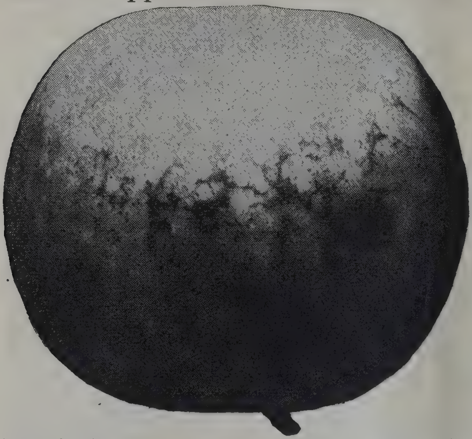


Fig. 4.—Mildew russeting of a Grimes apple. This blemish excludes infected apples from the highest market grades.

SPRAYING.

Finely divided sulphu such as that prepared b precipitating iron-sulphate solution with lime-sulphur[1] or as foun in various commercial sulphur pastes, is a most effective contr agent against apple powdery mildew. It is especially valuable a protective spray, but is less efficient against existing infect owing to the difficulty of thoroughly covering the mildew growth. Lime-sulphur solution is much more effective against active mildew, by its caustic properties immediately destroying all fungous growth with which it comes in contact. It likewise forms an excellent protective spray and is to be preferred where it may be safely employed, especially where pruning has not greatly reduced the number of hold-over infections. Copper sprays are less effective against mildew than the sulphur sprays and are also more expensive. Their use is on advisable during the period of hot burning sunlight in the interi regions, when the application of sulphur in any form results

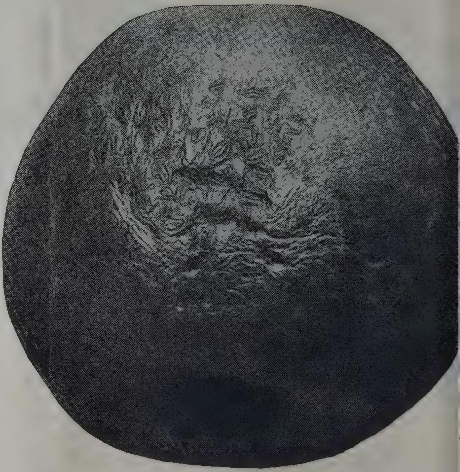


Fig. 5.—Jonathan apple, showing mildew infecti with resulting cracks formed in the russe area, causing the apple to shrivel.

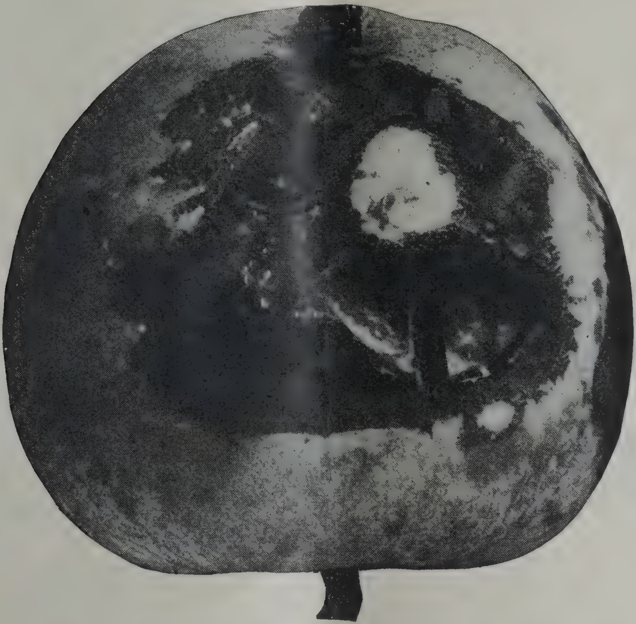
---

[1] For directions for the preparation and dilution of spray materials, see pp. 12–13.

vere burning of the fruit (fig. 6). Of the copper sprays, either ;utral Bordeaux mixture,[1] sal soda-Bordeaux mixture,[1] or amoniacal copper carbonate[1] is preferable because it does not stain :e fruit.

TECHNIC OF SPRAYING.

The technic of spraying for mildew is important. Since it is rgely a foliage disease, and since a single infected leaf may produce iough spores to infect many trees if proper conditions prevail, it important to cover every leaf. If the leaves are thoroughly prayed the twigs and fruit will be properly covered at the same ime. Attention should therefore be centered on thoroughly wetting he foliage. In this connection the wetting power of the sprays is ery important. Lime-sulphur possesses the best wetting power of ny of the sprays ordinarily used, but even with this material there s a tendency for it to form in drops, leaving unprotected areas beween. The use of a "spreader" is advisable with any of the sprays hat may be used. Among the most economical and effective spreadrs are casein[2] and saponin.[2]



IG. 6.—Pryor Red apple, showing "sulphur sunburn," the type of injury that invariably follows the application of sulphur in any form after the advent of intense sunlight in the interior irrigated apple-growing districts.

Any spray machinery or apparatus is efficient against mildew if t will drive the spray in a fine mist through the tops of the trees.

---

[1] For directions for the preparation and dilution of spray materials, see pp. 12–13.

[2] For directions for preparation, see p. 13.

A pressure of at least 200 pounds is necessary for this, and 2 pounds is desirable. Nozzles of the eddy-chamber or whirlpool ty have proved most efficient. With large trees it is advisable to st tion one man upon the tank or a tower to cover the tops of the tree while another follows upon the ground to cover the lower branche and the inside. Special attention should be given the terminals an the under surfaces of the leaves.

TIME OF SPRAYING.

The first application should be made when the cluster buds hav separated, but before full bloom (fig. 7). This is commonly calle the "cluster bud" c "pink" spray. I protects the earl foliage and the blossoms and harden tender varieties s that they are less subject to injury fron the following applications.

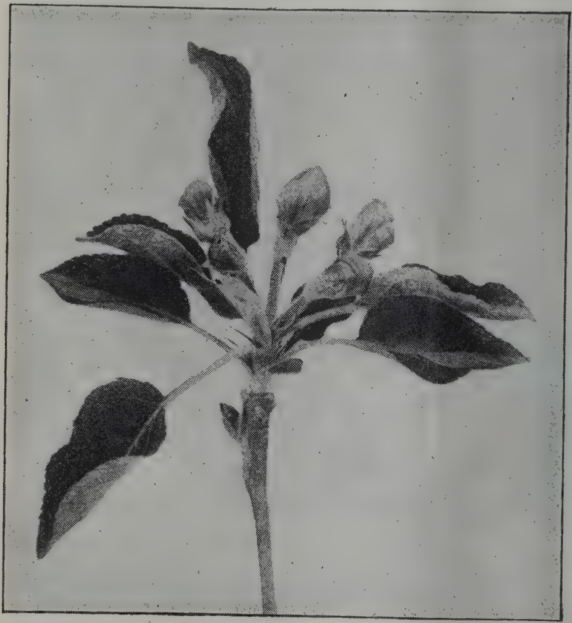


FIG. 7.—Cluster of apple buds at the right stage for the first mildew spray.

The second application, or "caly spray," should b applied as soon a most of the petal have fallen (fig. 8) Lime-sulphur solution may be combined with the arsenical used at thi time for codling-moth control. This spray is very important in mildew control and should not be omitted It is designed to destroy new infections and provide protection to the rapidly expanding healthy foliage as well as to the young fruit. On certain varieties of apples, notably the Stayman Winesap, the dropping of the fruit and foliage without any sign of injury sometimes follows the application of sulphur materials at this period, particularly if accompanied by humid weather conditions. This is especially true if the "pink" spray has been omitted. Early and frequent application of sulphur sprays is important in developing "sulphur immunity"[1] and in avoiding this injury.

---

[1] Ballard, W. S., and Volck, W. H. Loc. cit.

A sulphur spray should again be applied about two weeks later. the hot interior districts this constitutes the latest time at which lphur materials may ordinarily be used without danger of injurg the fruit exposed on the south side of the trees. It has been und that such injury, or "sulphur sunburn" (fig. 6), invariably llows the application of sulphur in any form in the hot districts when shade temperatures of 90° F. or more are experienced within wo weeks of the time of spraying. In these districts foliage burnng is usually of minor importance.

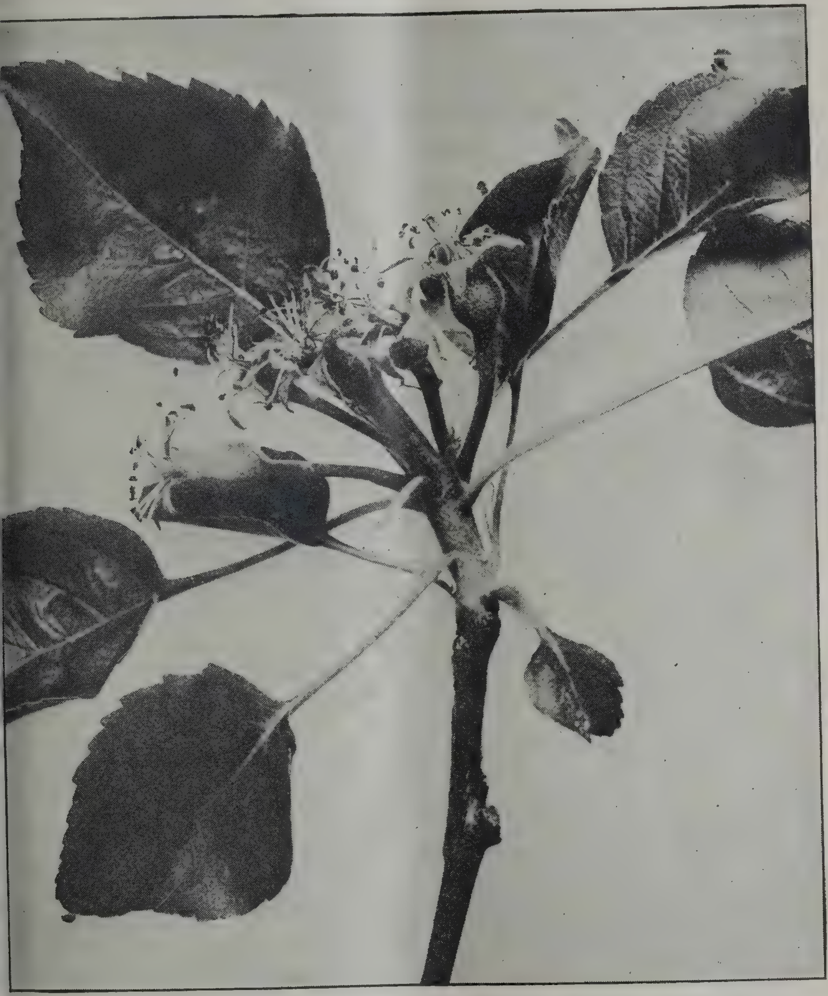


FIG. 8.—Cluster of young apples with the petals shed, the right stage for the second mildew spray and the first codling-moth treatment.

The fourth application should follow within two or three weeks nd at the time of the second spraying for codling-moth control. If mildew continues very serious in the orchard, sulphur materials must be used for effective control and are to be recommended in any case where the fruit crop is light. Otherwise one of the copper sprays may be used.

Later spraying at intervals of two or three weeks until the latter part of August is recommended where the disease has become established. This is important to insure sufficient healthy vigorous foliage to allow the formation of fruit buds and in the prevention of dormant bud infection.

Maintaining a vigorous growth condition is an important factor in rendering trees more resistant to mildew attacks. Proper attention to cultivation, fertilization, and irrigation therefore has an important bearing upon mildew control.

SPRAY MATERIALS.

The preparation of the more important spray materials for orchard use is outlined below.

Lime-sulphur solution.—Use the ordinary commercial concentrate at a dilution of 1 to 50. Greater strength adds no benefit in mildew control, while weaker strengths, even to a dilution of 1 to 100 will cause as much damage in burning exposed fruit in hot weather.

Iron sulphid, Ballard and Volck formula.—(For use where soluble sulphids cause serious injury, i. e., climatic conditions characterized by rainless, cool, and cloudy summer weather, with frequent heavy fogs that drench the foliage.) Dissolve 10 pounds of iron sulphate in a barrel containing 50 gallons of water. Add lime-sulphur solution until no more precipitate forms. Allow the precipitate to settle and drain off the clear liquid. Again fill the barrel with water, stir the precipitate, and allow to settle, and then drain off the clear liquid as before. Continue this washing process until the yellow color disappears from the clear liquid. Make up to 50 gallons for a stock solution. For spraying, stir the stock solution well, and dilute 10 gallons in 90 gallons of water to make 100 gallons of spray.

Under conditions prevailing in the hot interior regions this material will cause severe fruit injury or sulphur sunburn, the same as any other sulphur material.

Iron sulphid, Wenatchee formula.—Slowly add 2 pounds of granulated iron sulphate to 100 gallons of water in the spray tank, keeping the liquid well agitated. The iron sulphate goes into solution very quickly. Add 3 quarts of lime-sulphur solution (testing 34° Baumé) and use immediately.

Ammoniacal copper carbonate.—Dissolve 5 ounces of commercial copper carbonate (malachite) in 3 pints of ammonia (25 per cent solution, which should be diluted before using). First make a paste of the copper carbonate and water. Slowly add the diluted ammonia and stir well. Dilute to 50 gallons in the spray tank. Or proceed as follows in the preparation of modified eau celeste, which contains ammoniacal copper carbonate: Dissolve separately in water 2½ pounds of sal soda and 2 pounds of bluestone (in a wooden vessel). Add the resulting solutions to water in the spray tank and, with agitation, add 1 quart of 26 per cent ammonia, and finally make up to 50 gallons.

Neutral Bordeaux mixture.—Dissolve 4 pounds of bluestone in water in a wooden vessel and add to nearly 50 gallons of water in the spray tank. From a stock solution of lime, prepared by slaking a quantity of fresh stone lime in water, slowly add, with agitation, a small quantity at a time until the spray ution is neutral and make up to 50 gallons. The neutral point is reached en a red color is no longer produced by the addition of a few drops of a tassium ferrocyanid test solution. The latter is prepared by dissolving a all quantity of the chemical in a bottle of water.

Sal soda-Bordeaux mixture with lime (Burgundy mixture with lime).—Dis ve separately in water 4 pounds of bluestone (in a wooden vessel), 5 pounds sal soda, and 2 pounds of lime. Add, with agitation and in the order given, water in the spray tank, and make up to 50 gallons for use.

Casein.—Use ordinary commercial casein at the rate of 4 ounces to 200 gal is of spray. The casein must first be put into solution, and this is best complished by heating to the boiling point for about 10 or 15 minutes in ter to which has been added one-seventh as much sodium hydroxid as casein d. In this manner a stock solution may be prepared and a proportionate antity taken for use with each tank.

Saponin.—Prepared by making an infusion of soaptree bark and water. aptree bark may be had cheaply at most drug stores in 2-ounce packages. ld the contents of one of these packages to a quart of water and boil for 15 nutes. Strain and use the clear solution for 200 gallons of spray. Several fusions may be prepared from the same material, but it gradually loses ength.

Stock solutions.—If a considerable quantity of any of the above sprays is to be ed it will be found convenient to prepare stock solutions in advance of the raying operations. This may be done by dissolving a given quantity of the iterial in a measured quantity of water. For example, in preparing a stock lution of bluestone, proceed as follows: Weigh 50 pounds of bluestone, and spend it in a clean gunny sack near the top of a barrel containing 50 gallons water (the bluestone will dissolve over night). If the resulting solution is ll stirred, each gallon removed will contain 1 pound of bluestone.

SPRAYING SCHEDULE.

In order that the apple grower may have before him in a concise rm the recommendations for spraying against mildew offered in is bulletin, a condensed spraying schedule is given (Table I).

TABLE I.—*Spraying schedule for the control of apple powdery mildew.*

Application and time.	Materials.
st mildew spray ("pink spray"). Apply just before the blossoms open. (Fig. 7.)	Lime-sulphur, 1 to 50; or **iron sulphid.**
cond mildew spray (calyx spray). Apply as soon as most of the petals have fallen.[1] (Fig. 8.)	**Lime-sulphur**, 1 to 50; or iron sulphid.
ird mildew spray. Apply about two weeks after the calyx spray.	Do.
urth mildew spray. Apply about four weeks after the calyx spray.[1]	Lime-sulphur, 1 to 50, or iron sulphid;[2] or ammoniacal copper carbonate; or neutral Bordeaux mixture;[3] or sal soda-Bordeaux mixture.
ter sprays. Apply if necessary at intervals of about three weeks until the latter part of August.	Do.

[1] An arsenical for the control of the codling moth should be added to the second and irth applications.

[2] Use if the infection is severe or if the crop is light.

[3] Use where the danger of burning the fruit is to be avoided.

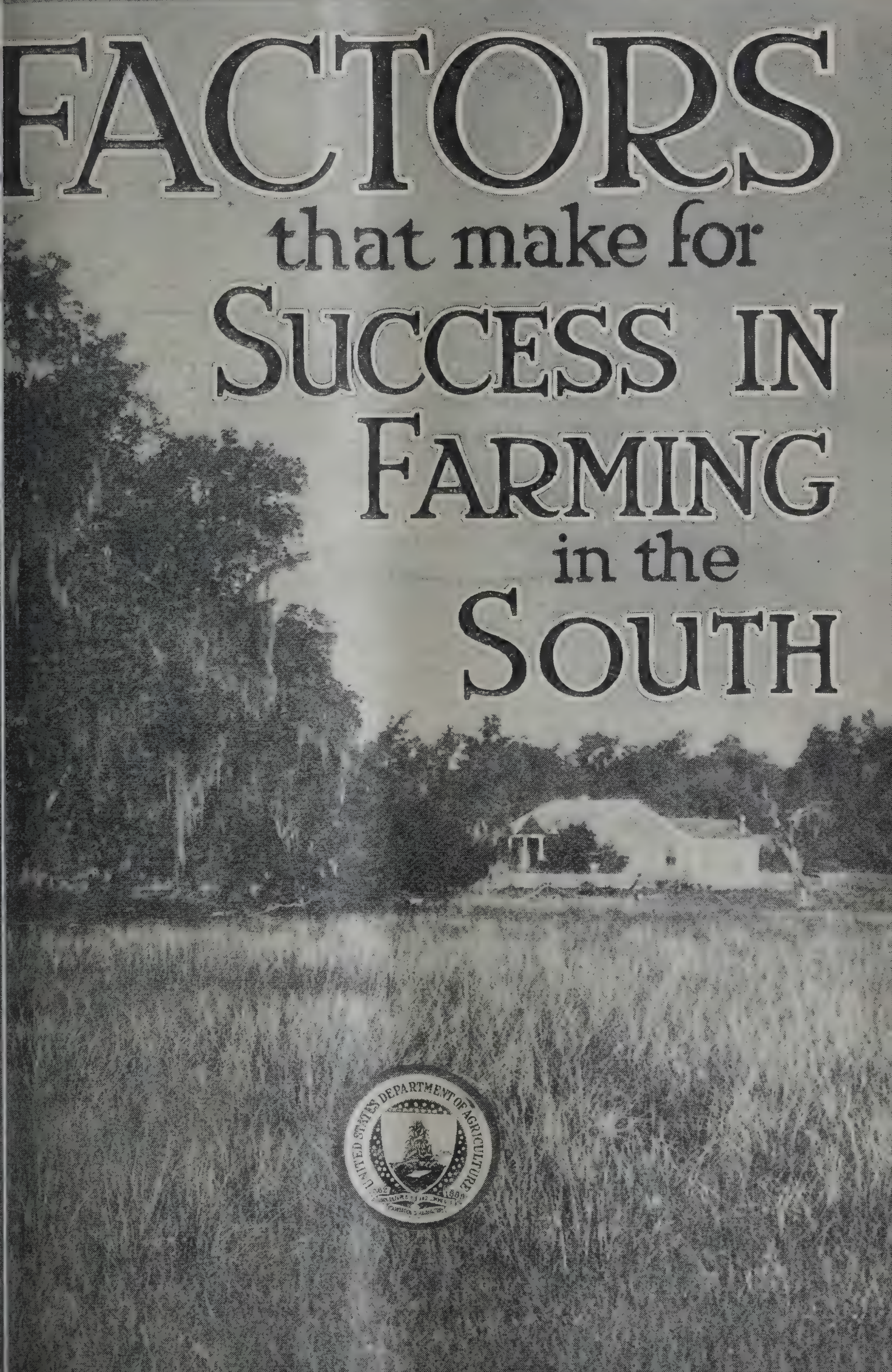
The more important applications as well as the preferred spray aterials shown in Table I are printed in boldface type. To insure maximum control the first four sprays should always be applied. It is believed that a consistent spraying program involving the use of these four applications will suffice in most cases and in ordinary seasons; but in orchards where mildew has become established it will be necessary to continue spraying throughout the growing season until the disease is brought under control.

Experience in the orchards of the Northwestern States has shown that apple powdery mildew is cumulative in its effects, gradually becoming more severe if not brought under control. The effects of spraying have also been shown to be cumulative, as it has been found impossible to eliminate the disease entirely or even greatly reduce it with any one spraying alone; but a season's consistent effort in spraying has always brought marked results in the way of control.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

FARMERS' BULLETIN 1121
United States Department of Agriculture

FACTORS that make for SUCCESS IN FARMING in the SOUTH



THIS BULLETIN is designed to present, by pictures, charts, and brief text, some of the more important and fundamental factors that make for success on the Southern farm.

Its object is to arouse the interest of the farmer in these factors, so essential to success, and induce him to inquire further into the matter, with the idea of improving his own practice and management.

Contribution from the Office of Farm Management and Farm Economics
H. C. TAYLOR, Chief

Washington, D. C. September, 1920

FACTORS THAT MAKE FOR SUCCESS IN FARMING IN THE SOUTH.

C. L. GOODRICH, *Agriculturist.*

CONTENTS.

	Page.
arm records	3
arm incomes vary	5
Why do such variations occur?	5
Practices that help to maintain and increase crop yields	8
nfluences of systems of farming on yields per acre	16
Practices that lower the grade of the product	18
Influence of quality in dairy cows on income	19
Efficiency in the use of labor	21
Utilizing untillable and waste land	27
Size of the business	28
Organization of farm enterprises	30

FARM RECORDS.

THE FARMER invests capital in land, labor, and equipment for the production of crops, of live stock, and of animal products. t is self-evident that to reach the highest return for time and capital xpended he must use his land and equipment, and expend his labor nd supplies, with the greatest efficiency and economy possible under is particular climatic, soil, and economic conditions, and according o the information available as to the practices best suited to that nvironment.

To determine whether he is managing his farm to the best advantage, it is desirable that he not only keep such records as will nable him to make an analysis of his farm business, but also that e compare notes with others to gain knowledge and efficiency from heir experience.

These records may range from simple accounts to elaborate systems of bookkeeping, showing receipts, expenses, and inventories for he farm as a whole, or even to complete cost-account records for each ndividual enterprise on the farm.

The following summary of the business of a Southern farm will give a general idea of the nature of the facts that may be emphasized y keeping farm records.

Summary of a farm business.

Fixed capital in real estate (276 acres)		$9,000
Working capital:		
Live stock	$1,831	
Implements and machinery	280	
Feed and supplies	650	
Cash to run farm	400	
Total working capital		3,161
Receipts from—		
Crop sales	8,435	
Live-stock sales	75	
Live-stock product sales	225	
Miscellaneous receipts	0	
Increase in inventories	552	
Total receipts		9,287
Expenses:		
Hired labor, including cropper	4,131	
Family labor	0	
Live-stock expense	385	
Miscellaneous crop expense	1,487	
Improvements, machinery, and repairs	235	
Taxes and insurance	85	
Total expenses		6,323
Farm income		2,964
Interest on capital		961
Labor income		2,003

Tilled acres	202¾	Yield per acre of corn, bushels	20
Work animals	8	Yield per acre of oats, bushels	50
Acres per work animal	25⅓	Per cent tilled land in cotton	69
Days of productive work per work animal	120	Per cent tilled land in corn	21
Yield per acre of cotton, pounds	375	Per cent tilled land in oats	5

The farm receipts minus expenses make the farm income—the total amount earned by the farmer and his capital, except what the farm furnishes the family in the way of food, fuel, shelter, and other comforts.

It is customary to divide the farm income between the farmer and his capital by deducting interest on the capital from the farm income and assigning what is left to the farmer as his labor income. Another way is to make a fair estimate of the value of the farmer's time, and subtract this from the farm income, the remainder being regarded as the earnings of capital.

Either the farm income, the labor income, or the earnings on the investment may be used as a measure of success and efficiency in operating the farm. In this bulletin farm income has been used for this purpose.

FARM INCOMES VARY.

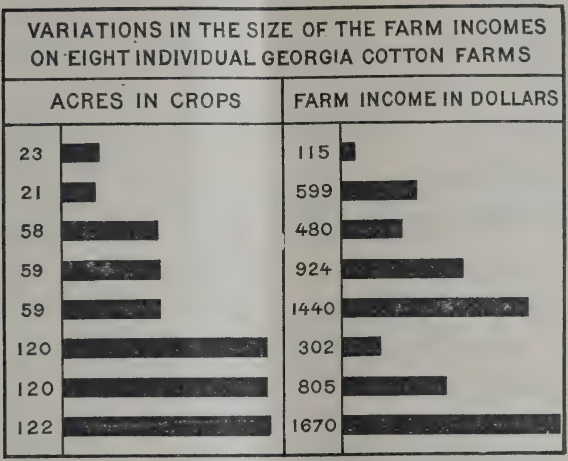


FIG. 1.—Farm incomes vary.

In a community of farms in Georgia operated by owners the following range of variations in farm incomes occurred:

TABLE I.—*Range of variations in a community of farms.*

Number of farms.	Size of farms.	Range in variations in farm incomes.
9	1-mule farms	$67 to $620
23	2-mule farms	− 49 to +1,227
25	3-mule farms	114 to 1,379
18	4-mule farms	−236 to +3,013
19	5-mule farms	302 to 1,853
15	6-mule farms	66 to 2,644

WHY DO SUCH VARIATIONS OCCUR?

In the following pages some of the factors which tend to raise or lower the farm income and which influence success in farming are indicated by pictures, charts, and figures.

THE FARMSTEAD.

A well-planned farmstead, with a comfortable, well-arranged, attractive farmhouse, not too large or too expensive, with a near-by ample garden and well-planned barn, crib, stable, poultry house, and other necessary farm buildings, adapted in capacity and location to the character and size of the farm, will contribute in great measure to the welfare of the farm family and to the success of the administration of the farm business. A poorly-planned farmstead entails a waste of time and energy in performing many of the activities of the farm which might otherwise be expended in profitable production.

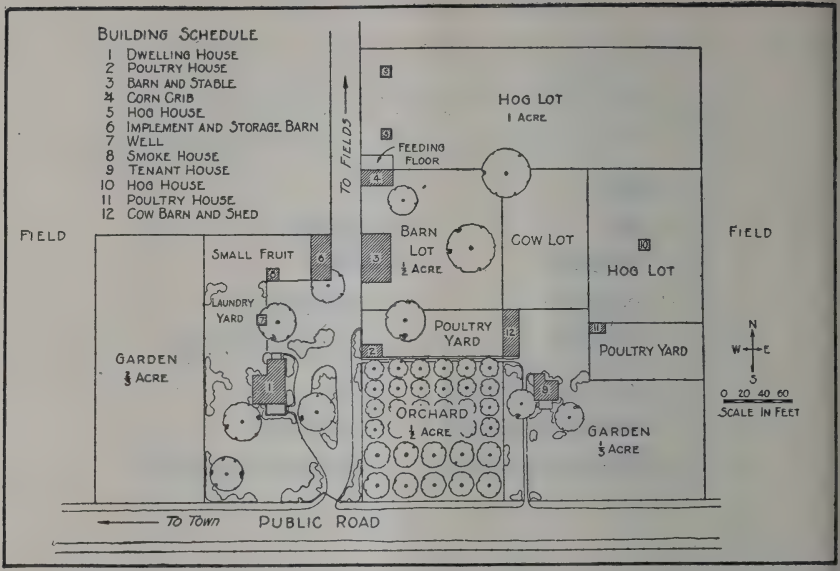


FIG. 2.—Suggested layout for Southern farmstead. (Grouping prepared by Division of Rural Engineering, Bureau of Public Roads.)

QUALITY OF BUSINESS.

Quality of business has a very important influence on the size of the farm income.

Quality is indicated by crop yields per acre, by returns per head of productive live stock, by the grade of the product, and by the number of days of productive work done per man and per work animal.

While the character of the soil and the climatic conditions have great influence on yields of crops and the production of live stock quality may be influenced by cultural methods and by systems of farming.

CROP YIELD PER ACRE.

On the two farms, A and B (see fig. 3), the capital invested is only a little over 5 per cent in favor of farm B. The number of work animals is identical on the two farms. The number of tilled acres is practically the same. Farm B has only one acre more in cotton and three acres more in corn than Farm A.

The two farms are about as evenly matched as it is possible to find two farms when measured by capital invested, number of work animals, tilled acres, and acres in each of the principal crops.

However, when compared as to quality of business measured by crop yields per acre, we find that Farm B produced 109 pounds more int cotton per acre han did Farm A, r about 50 per cent nore. The corn ield, not shown in he figure, also was bout 30 per cent arger on Farm B.

The cotton on arm B graded igher than that on arm A and sold or 1½ cents more er pound.

The better yield er acre and the igher grade conributed largely to naking receipts of arm B 70 per cent arger than those of arm A.

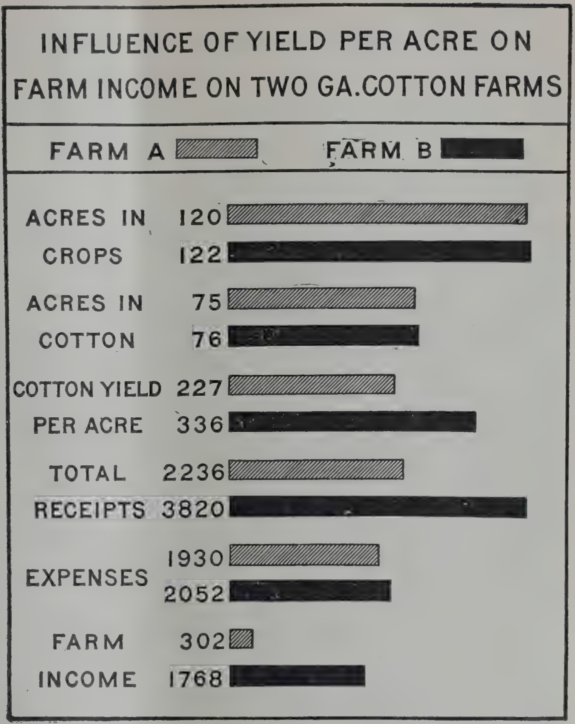


FIG. 3.—Influence of yield per acre on farm income. (The farm income represents the combined earnings of the farmer and his capital, exclusive of food, fuel, and shelter furnished by the farm to his family.)

Farm A.		Farm B.	
Capital invested	$5, 814	Capital invested	$6, 145
Work animals	5	Work animals	5
Acres in crops	120	Acres in crops	122
Acres in cotton	75	Acres in cotton	76
Acres in corn	37	Acres in corn	40

While total curent expenses were ractically the same n each farm, armer B showed a igher quality of nanagement by pending more money for fertilizers to increase yields and less for labor than did farmer A.

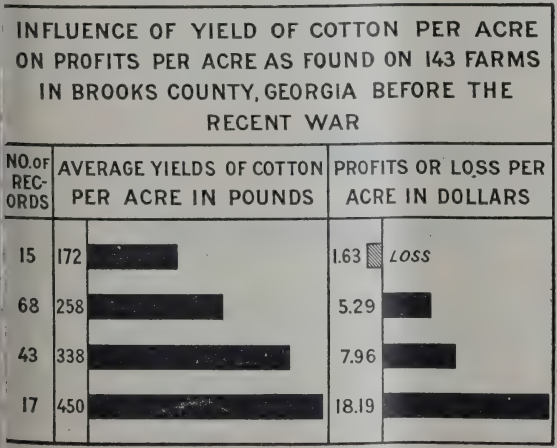


FIG. 4.—Influence of yield per acre on profits per acre.

The effect of increased yield and higher grade of product is conclusively shown in the farm income—receipts minus expenses. *The farm income on Farm B was more than five times as large as on Farm A.*

That variations in yield per acre and grade of product cause variations in the farm income is shown in figures 3 and 4.

PRACTICES THAT HELP TO MAINTAIN AND INCREASE CROP YIELDS.

GROWING COWPEAS.

FIG. 5.—Growing cowpeas for seed and fertility is profitable both directly and indirectl

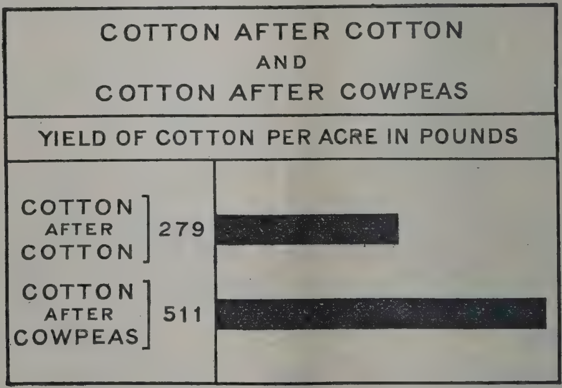


FIG 6.—Effect of cowpeas on cotton yield. (In both cases 336 pounds of fertilizer were applied to the crop.)

GROWING VELVET BEANS.

FIG 7.—Do velvet beans increase the quality of the business? (See figure 8.)

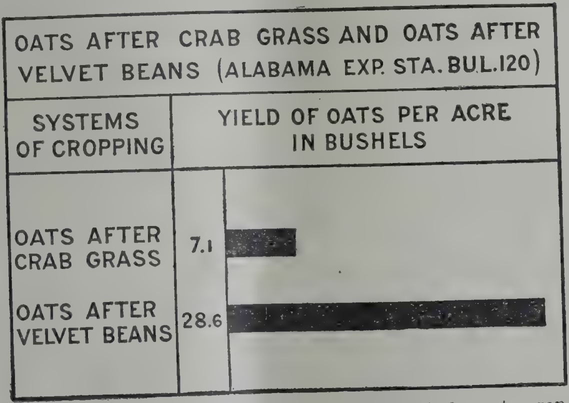


FIG. 8.—In this case velvet beans quadrupled the oats crop. (One hundred pounds of acid phosphate were applied in each case.)

OTHER LEGUMES.

Other legumes such as soy beans, peanuts, vetch, bur clover, lespedeza, red, alsike, and sweet clovers, and Canada field peas, grown as catch crops or winter cover crops or as a part of the regular cropping system, are all useful in maintaining or increasing fertility and thus influencing the quality of the business and the farm income.

On a farm in Caroline County, Va. (Farmers' Bulletin 924), the regular practice had been to grow corn on the land one year in three and to allow each field to rest during the other two years. The resting

FIG. 9.—Red clover, the old stand-by as a feed and fertility plant, is a great quality and income maker.

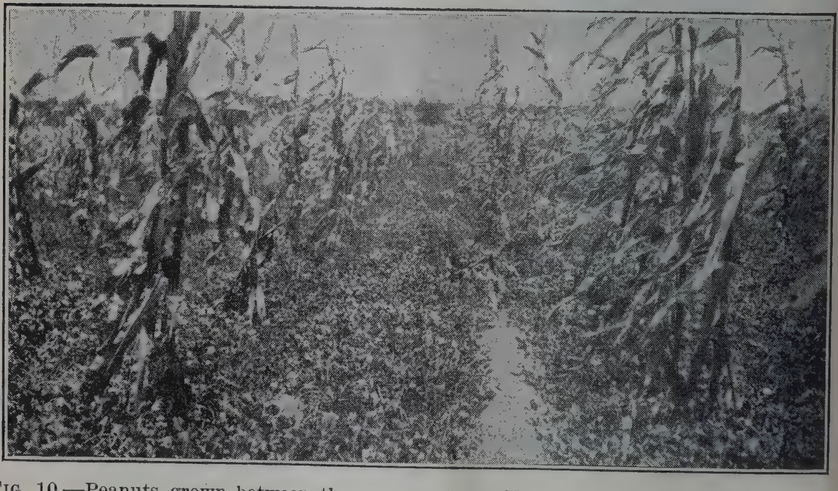


FIG. 10.—Peanuts grown between the corn rows provide hog feed and increase fertility. (See Farmers' Bulletin 985.)

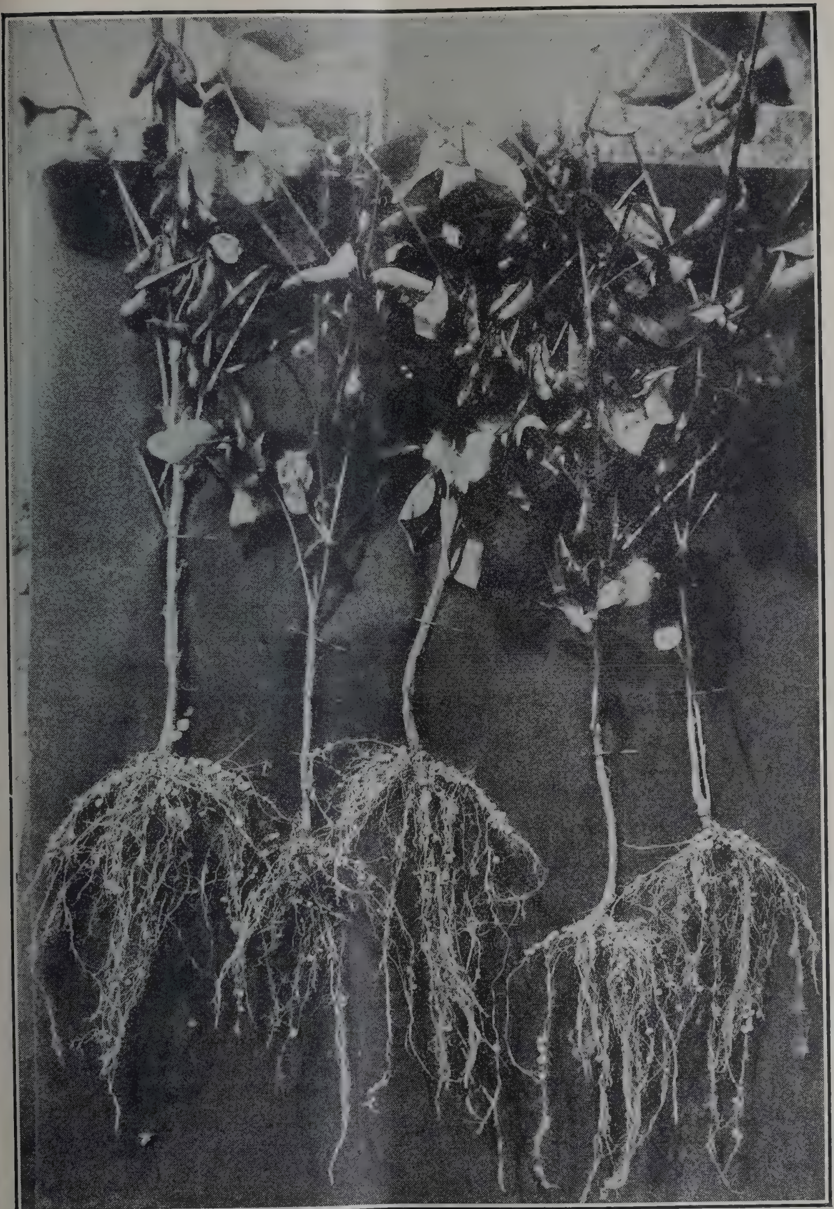


FIG. 11.—The soy bean, a wonderful fertility maker, showing nodules on the roots. Similar nodules of varying size occur on the roots of all legumes. It is through these nodules that the legumes, working in cooperation with nitrogen-gathering germs that live in the nodules, are able to accumulate free nitrogen from the air. This makes it possible for the farmer who makes a practice of growing legumes to increase with economy the quantity of his crop and live-stock production, and by so doing add to the farm income.

process was to allow weeds to grow up and thus accumulate fertility for another crop of corn. With this system of cropping, the yield of corn ranged generally from 15 to 18 bushels.

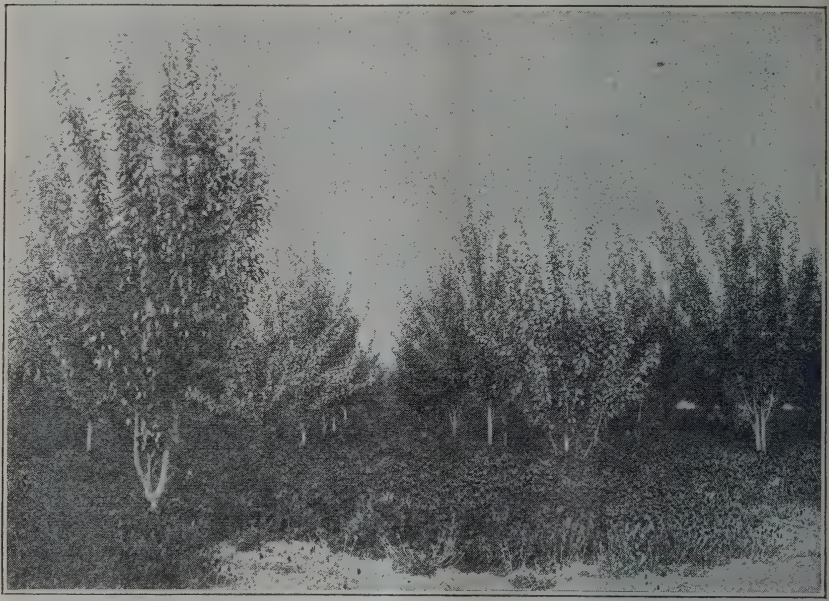


FIG. 12.—Crimson clover planted in a pear orchard as a winter cover crop and fertility maker.

Figure 14 shows the crop growth on a part of the farm while still under this system.

The improvement of the soil on this farm began by first planting one of the poorest fields with cowpeas. The cowpeas were cut for hay and the stubble disked and seeded to crimson clover. The following spring the crimson clover crop was turned under and the field planted with corn. At the last working of the corn crimson clover was again sown. The following spring the process was repeated by turning under the crimson clover and

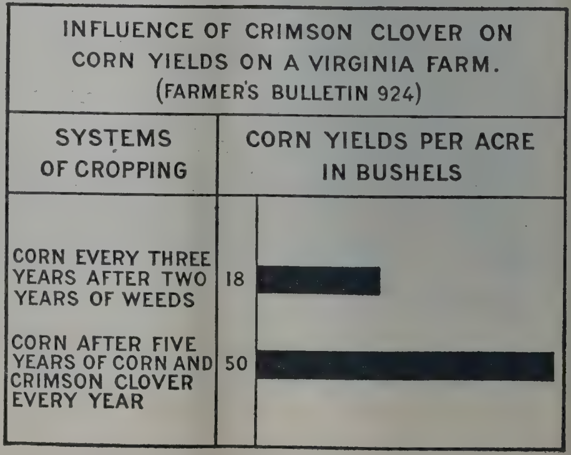


FIG. 13.—Results of growing crimson clover for increasing the corn yield on this Virginia farm.

planting corn again on the same land. This practice was continued for 5 years. The third year the yield of corn was about 40 bushels to the acre and the fifth year the crop made a yield of 50 bushels to the acre.

Figure 15 shows the change that has taken place under this method of cropping.

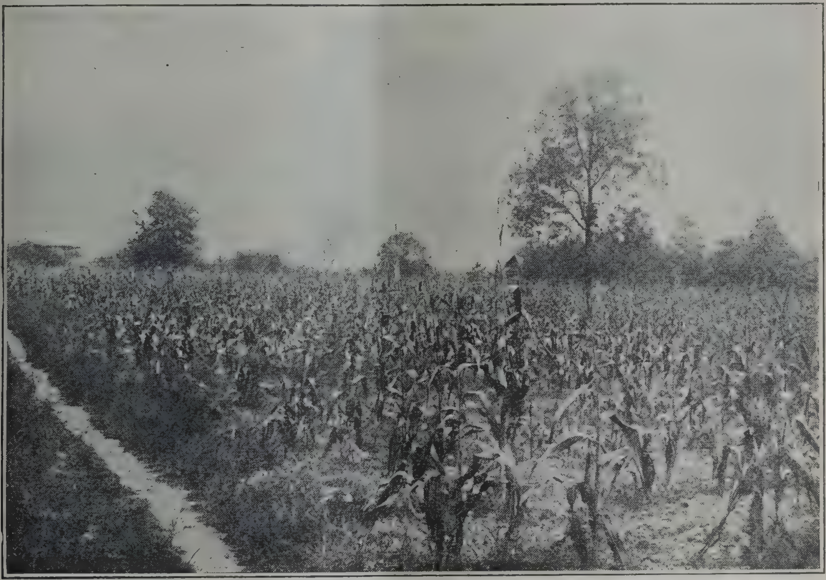


FIG. 14.—Yield too low to pay cost of production. (Farmers' Bulletin 924.)

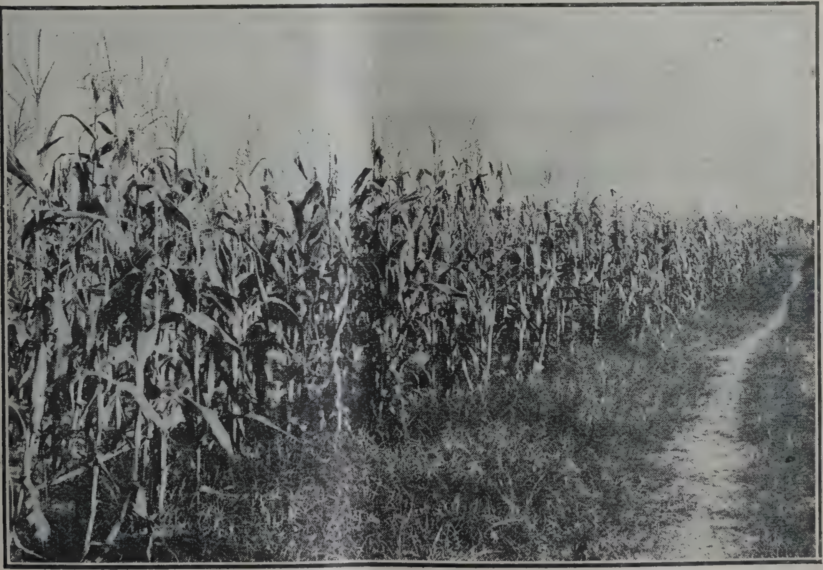


FIG. 15.—A 50-bushel crop after crimson clover. Same field shown in figure 14. (Farmers' Bulletin 924.)

FIG. 16.—Vetch, a winter legume, a good hay plant and a fertility and quality maker. Not grown as generally as its value would warrant. (Farmers' Bulletin 924.)

HARVESTING PRACTICES.

Harvesting practices influence directly the amount of the product secured, and therefore influence the farm income. For instance, delay in harvesting legumes for hay may result in loss of the leaves, thus reducing the amount of hay. Overcuring may have the same result. When grains are kept standing too long shattering diminishes the yield. Soy beans shatter badly if harvested when overripe and dry. Pulling corn fodder diminishes the yield of the grain.

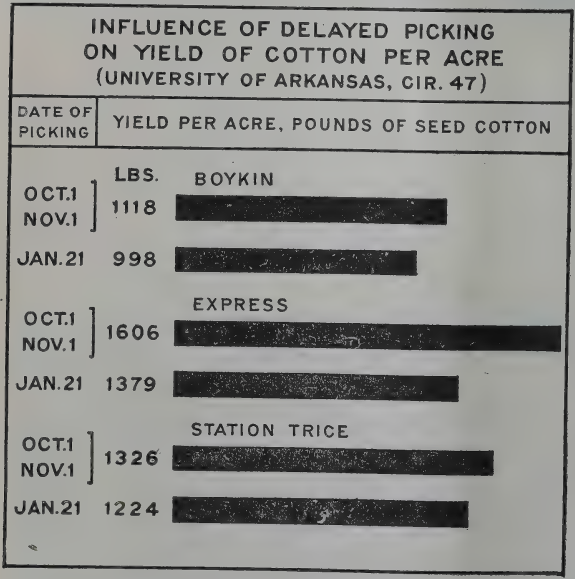


FIG. 17.—How time of picking influences yield of cotton.

Figure 17 shows graphically the loss in weight of cotton caused by delayed picking.

SELECTION AND CARE OF SEEDS.

A factor that has an important influence on yields is the practice of the farmer or the seed grower in harvesting and caring for the seed. Many farmers can increase the quality of their farm business by better seed selection and care.

Seed should be selected during or before regular harvest, from strong prolific mature plants, and should be properly cured and cared for till planting time. Testing for germination is not enough. A fine stand of plants may be obtained from inferior seed from non-prolific plants, but the resulting yields will not be the best possible.

Figure 18 shows two men gathering seed corn in the field. They are searching for seed ears from plants that have made good yields. Seed corn selected in this manner, properly cured and kept dry, will not fail to produce a good stand of strong prolific plants.

One farmer selected seed corn in the field and cured and cared for half of it by approved methods. The other half he placed in a sack in the corn crib with the feed corn. The properly cured seed produced 5 bushels per acre more than the seed cured in the corn crib. (Bureau of Plant Industry Circular 95.)

The same principle followed out in the selection and care of seeds of other crops will not fail to have a good influence on the yield of the crop and the farm income.

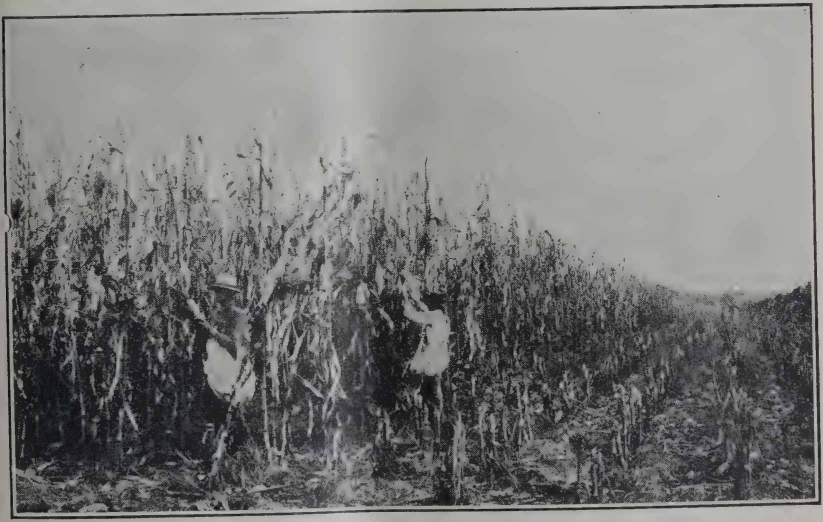


FIG. 18.—Selecting seed corn in the field.

INFLUENCE OF SYSTEMS OF FARMING ON YIELDS PER ACRE.

The farms for which yields are presented in figure 20 are adjoining, and originally had the same crop-producing power. Farm No. 1 has been under continuous grain cultivation and has never received any farm manure or other humus-forming materials. The land has been reduced in wheat-producing power from 25 to 8 bushels per acre. Farm No. 2 has received regular and liberal dressings of manure and has produced wheat, corn, oats, timothy, and clover in rotation. There has been no apparent decline in crop yields. (University of Minnesota Experiment Station Bulletin 53.)

FIG. 19.—Continuous grain culture—decreasing yields.

On typical cornbelt prairie soil in Illinois that yielded over 70 bushels of corn per acre when brought under cultivation (see fig. 22),

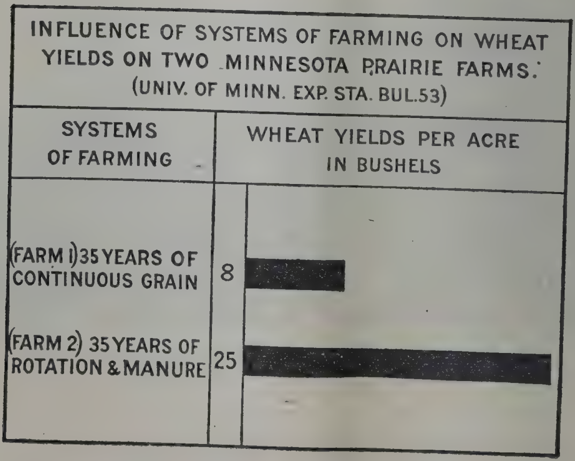


FIG. 20.—Effect of rotation and manure on wheat yields.

9 years of continuous corn culture reduced the yield to 27 bushels; n like soil a system of corn, oats, and clover in rotation, plus manure rom live stock, not only maintained the original yield but increased it o 96 bushels per acre. (University of Illinois Experiment Station ulletin 125.)

An occasional Northern example has been used, as will be noted on ages 16 to 19, to illustrate a principle when no clear-cut Southern ecords were at hand. The principles taught, however, hold good or all sections.

FIG. 21.—Grain in rotation on prairie farm.

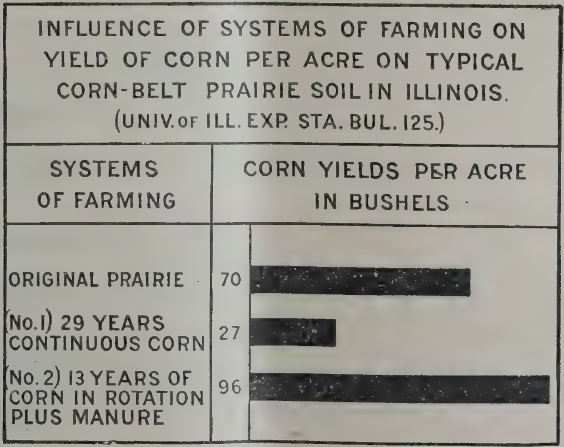


FIG. 22.—Rotation and manure give bigger yields than virgin prairie soil.

PRACTICES THAT LOWER THE GRADE OF THE PRODUCT.

Practices that lower the grade or quality of the product reduce the farm income.

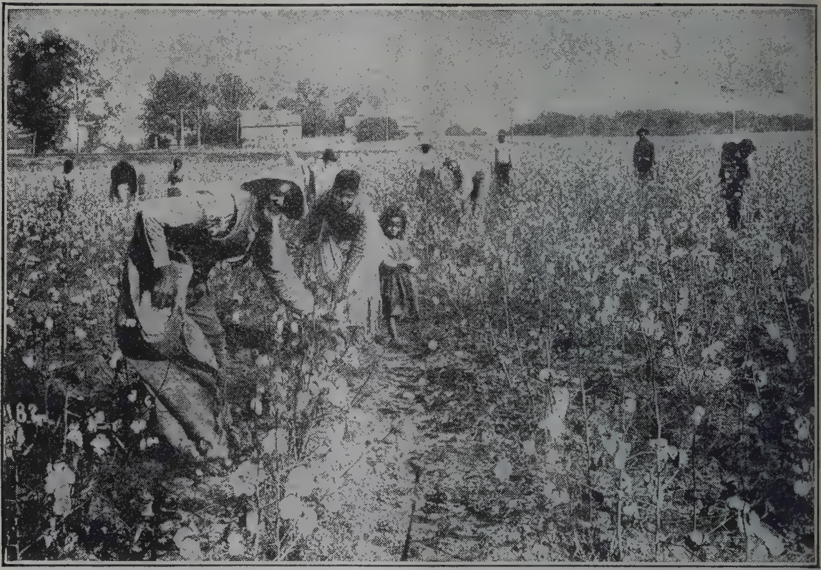


FIG. 23.—Delayed cotton picking lowers the yield and the grade of the product.

Figure 24 shows graphically the influence of delayed picking on the grade and value of cotton.

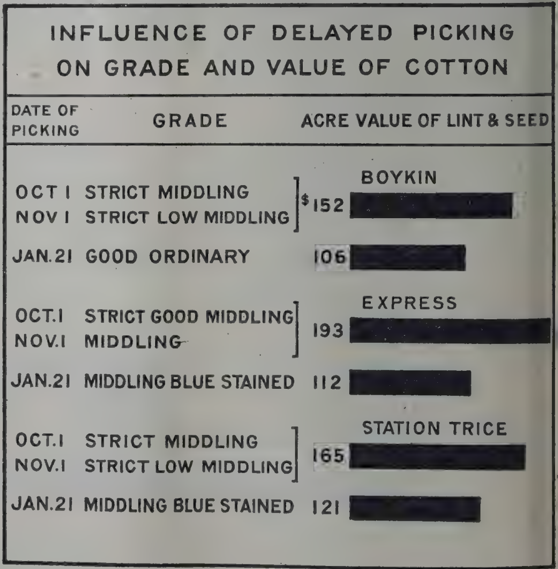


FIG. 24.—Delayed picking lowers grade and reduces return (Compare with figure 17.)

Comparing figure 24 and figure 17, page 14, it will be seen that delayed picking of this cotton resulted in a reduced yield and a lowering of the grade. The average money loss on equal acreages of these three crops, due to delaying picking till January, was more than one-third, or $57 per acre, on the 1918 crop.

Ten acres of this cotton picked at the proper time in the ll would return as much money as 15 acres picked in January, and e additional five acres could be used to produce food and feed d other crops that would not interfere seriously with the cotton cking.

Late cutting of hay usually results in lower quality, owing to e conversion of nutrients into less digestible forms or the transr of nutrients from stem and foliage to root and seed, the latter ten shattering out during harvest, leaving a hay of low grade. The me practices may result in loss of foliage. This loss of leaves may so be caused by overcuring the hay and thus lowering its grade.

Corn stover left standing till the blades dry up or are frosted is inferior quality to that cut at the proper time.

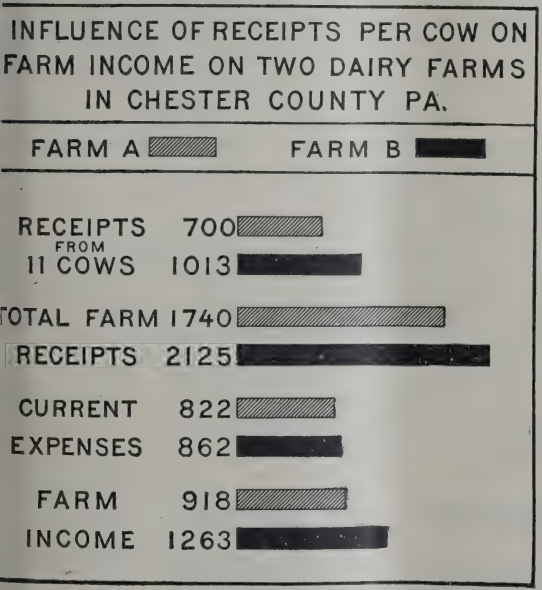
Truck and fruit crops may deteriorate in quantity and quality by te harvesting. Too early harvesting may produce a low grade as ell as a small yield.

Other crops and products also suffer deterioration in yield and lue when more is planted than can well be cared for. Why not ay safe? Why not harvest only high-grade products by limitg the acreage to what can be well cared for and harvested at the roper time?

NFLUENCE OF QUALITY IN DAIRY COWS ON INCOME.

Figure 25 shows some facts about two Pennsylvania dairy farms. These farms are identical in farm area, number of work animals, and number of dairy cows, and vary only slightly in crop area and total current expenses.

Farm B, however, shows an increase of $28 in receipts per cow, or nearly 44 per cent over Farm A, due to better cows or better feeding and care, or a combination of the two—in other words, better quality of business. This higher quality of business is reflected directly in



IG. 25.—Over $300 difference in income, attributable mostly to difference in yield per cow.

Farm A.		Farm B.	
arm area	80	Farm area	80
rop area	46	Crop area	43
ork animals	3	Work animals	3
airy cows	11	Dairy cows	11

FIG. 26.—High-yielding cows are essential to profitable dairying.

increased total receipts and in a farm income larger by more tha one-third.

One of the most important of the practices that influence th quality of the dairy business is the testing of the individual cow for quantity of milk and butter fat produced, and keeping a recor of the findings.

The first year of such testing and record keeping for a Virgini dairy herd of 42 cows (prior to the war) revealed the facts show in figure 27. Practically one-fourth of this herd was not producin enough milk to pay expenses.

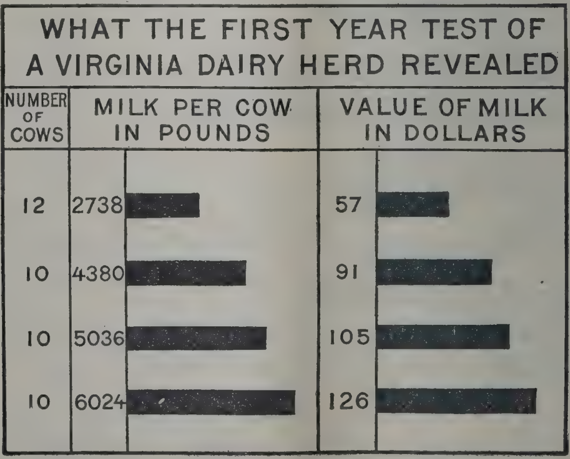


FIG. 27.—Showing that the best 10 cows gave more than twice as much milk as did the poorest 12.

EFFICIENCY IN THE USE OF LABOR.

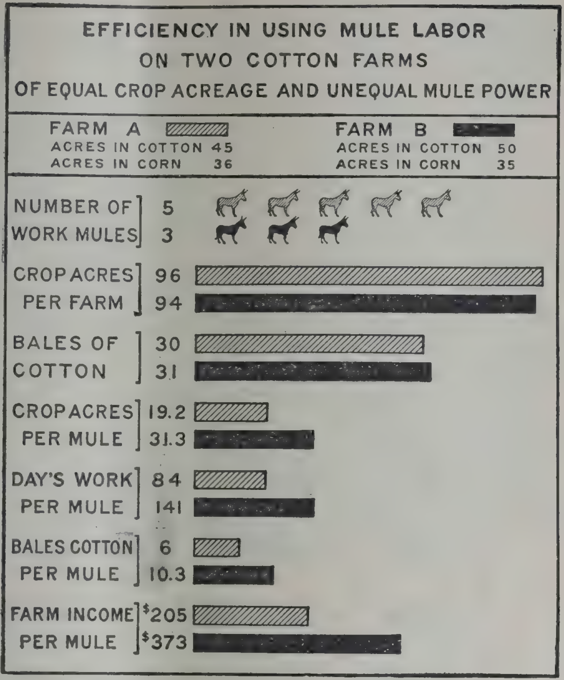
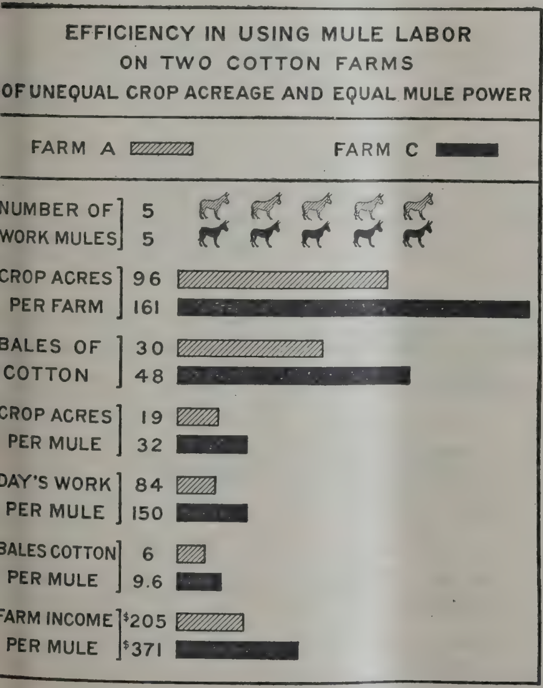


FIG. 28.—Three mules do more work than five in this case.

Another important
ctor influencing the
ality of the business
d the size of the
rm income is the
iciency with which
e labor of men and
imals is utilized.
me farmers reach
high degree of skill
so handling men
d mules as to get
rge returns for the
bor expended.

Figure 28 shows
aphically the utili-
tion of mule power
two cotton farms
ith practically the
me number of crop
res. Farmer A used
ve mules to work the 96 acres of crops, while farmer B worked 94 acres with three mules. The three-mule farm worked over 12 acres more per mule, put in 57 more productive days per mule, and earned $168 more farm income per mule.

In figure 29 farmer C, a five-mule farmer, by putting his five-mule equipment on a larger farm than did farmer A in figures 28 and 29, was able to handle them with practically the same efficiency as his neighbor, farmer B (see fig. 28), handled his three



IG. 29.—One 5-mule outfit covers 65 more crop acres than another.

mules, and therefore earned a much larger income. Farmer C worke 13 acres more per mule than farmer A, put in 66 more productiv days per mule, and earned $166 more farm income per mule.

Farmer A ranks low when measured by efficiency in utilizing mul labor.

Figure 30 shows graphically for 159 farms in Georgia that an increase in the number of acres per mule and productive day's wor per mule have a tendency to increase the farm income.

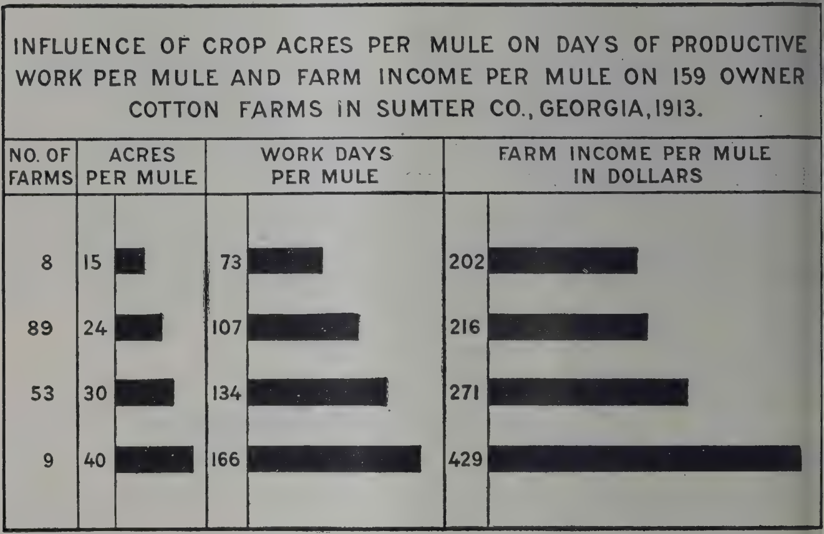
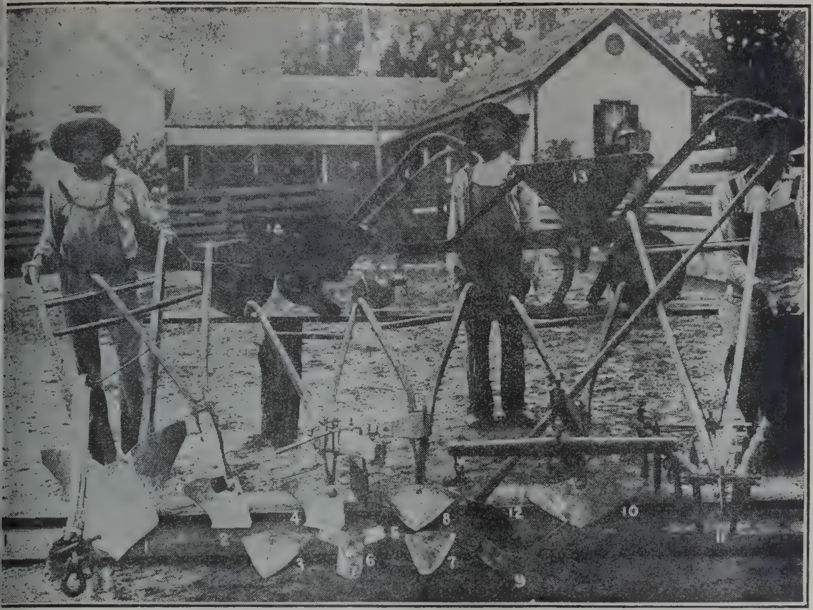


FIG. 30.—Relation between acres per mule and day's work per mule, and farm income.

LABOR MAY BE SAVED BY THE USE OF IMPROVED MACHINER

Differences in practice in the use of implements make considerabl difference in the labor requirements and labor cost of growing crop. Figure 32 shows the differences in the average amounts of ma labor required to produce cotton, corn, and oats in Sumter Count Ga., and Ellis County, Tex.

In Sumter County, Ga., though the farmer and his laborer sometimes drive two horses or mules, one-horse implements are general used in preparing the ground, planting, and cultivating. In Elli County, Tex., the farmer and his helper drive from two to fou horses or mules and use improved implements and machines. Th Texas man averages one trip across the field in throwing up a plan bed. The Georgia man will average five trips. The Texas ma cultivates both sides of the row and also the middle at one tri across the field. The Georgia man makes two or three trips accomplish the same end. The Georgia man with his one-horse implements expends twice as much man labor on the three crops represented in the figure as does the Texas man.



IG. 31.—Some types of implements used in growing cotton; (1) middle buster or lister; (2) Georgia stock with half shovel or turning plow; (3) small solid sweep; (4) Georgia stock with half shovel and fender attached for use in barring off; (5) 10-inch heel sweep or heel scrape; (6) diamond scooter; (7) broad shovel; (8) Georgia stock with solid sweep and 18-inch heel sweep attached; (9) 18-inch heel sweep; (10) Georgia stock with 18-inch solid sweep attached; (11) one-horse spike tooth or narrow tooth cultivator; (12) cotton hoe; (13) fertilizer distributor; (14) cotton planter. With the exception of No. 1, the middle buster, and No. 12, the hand hoe, these are all one-man, one-mule implements. (Yearbook Separate 377.)

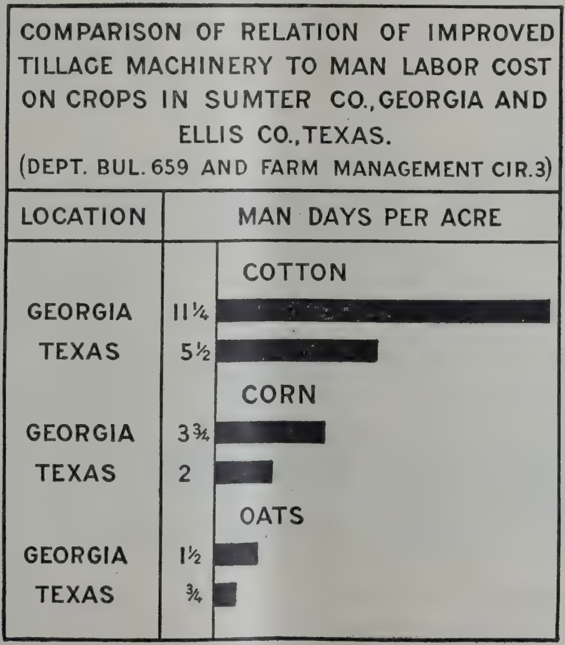


FIG. 32.—Man days per acre reduced by half through use of improved machines and big teams.

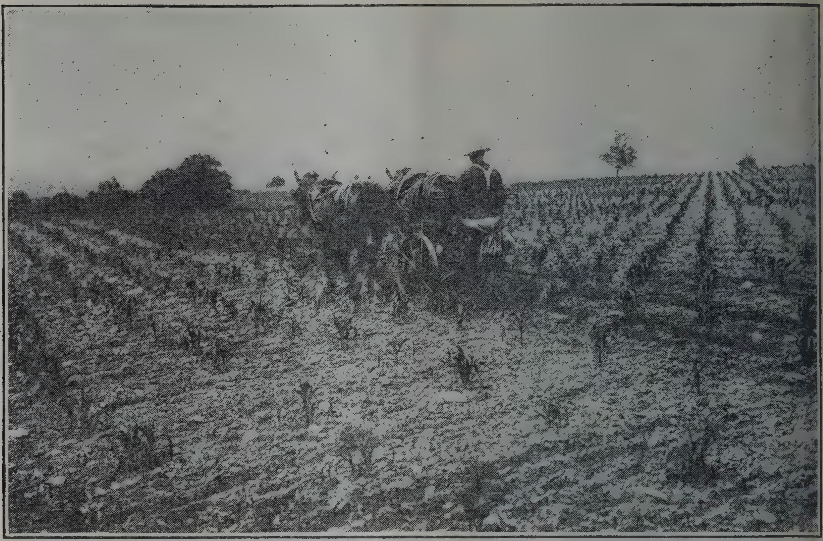


FIG. 33.—One man with two horses and a riding cultivator cultivating both sides of a row at one trip and cultivating not only lengthwise of a field but also across a field planted by one man with a two-horse, two-row check row planter. Time was saved by this practice as compared with that in figure 36, both in planting and in cultivating the crop. (Other methods of making labor more efficient by the use of machinery and other devices are described in Farmers' Bulletin 989.)

Figure 34 shows graphically how the cost of cultivating corn was lowered on an Alabama farm by using a check-row planter. Farmers' Bulletin 310, in describing the farm, says:

"When the rows were laid out with the contour of the land and cultivated only one way the cost of cultivation averaged $1.38 per acre and the cost of hoeing $0.70 per acre. When the corn was check-rowed and cultivated both ways the average cost of cultivation and hoeing was reduced to $1.10 and $0.21, respectively, a saving of 20 per cent in the cost of cultivation and 70 per cent in the cost of hoeing."

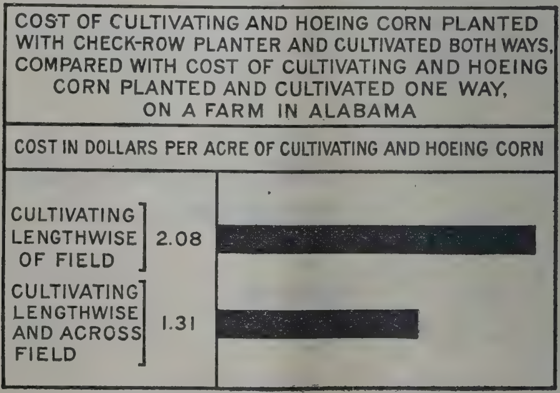


FIG. 34.—It pays to cultivate thoroughly.

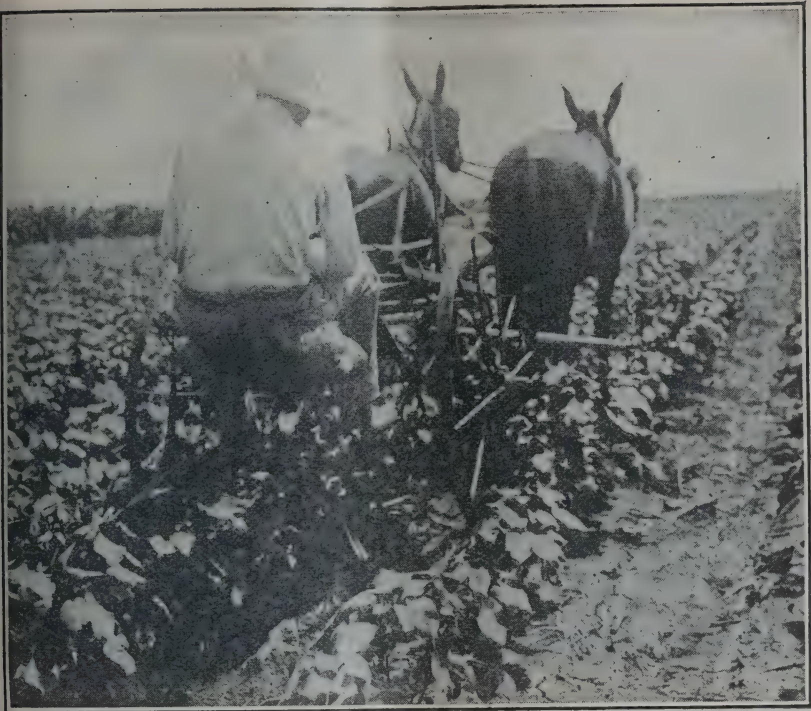


Fig. 35.—A labor-saving implement. A two-horse four-shoveled cultivator with small sweeps instead of shovels, extensively used for the tillage of cotton and corn in Texas and Oklahoma and some other parts of the Cotton Belt. (Department Bulletin 511.)

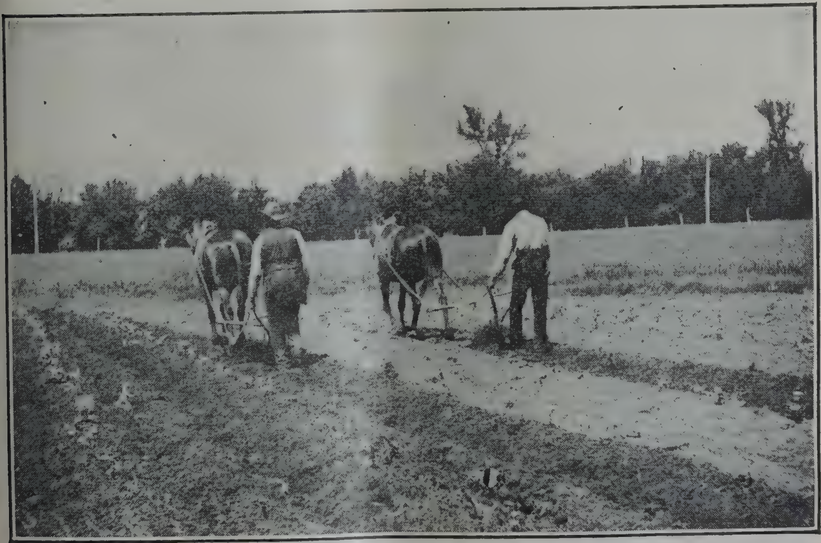


Fig. 36.—Two men and two mules, with one-horse cultivators, cultivating one side of a row at a time, of a crop planted with a one-man, one-horse, one-row planter. (Compare with figure 33.)

SAVING MAN AND HORSE LABOR BY GRAZING DOWN CROPS.

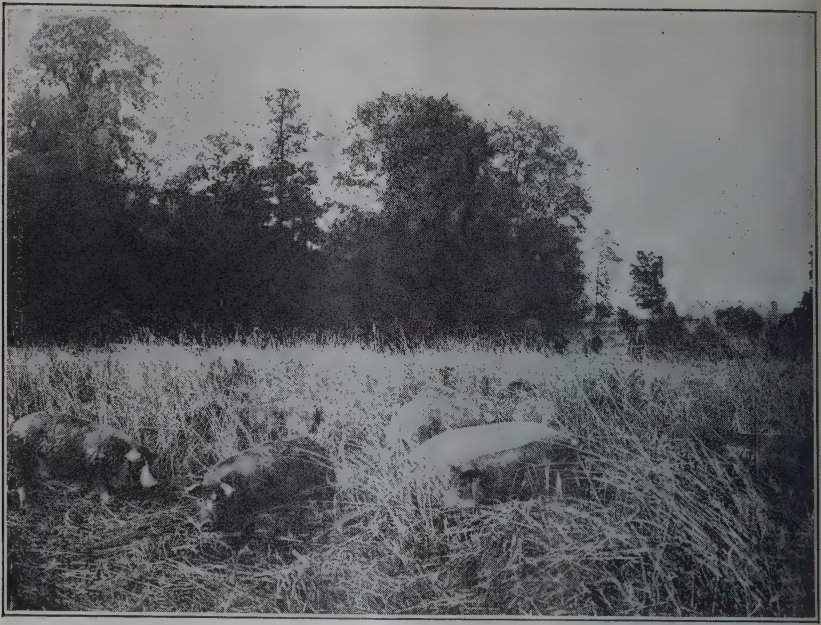


FIG. 37.—On many farms man and horse labor may be saved at harvest time by grazing down part of the feed crops of the farm with hogs, cattle, or sheep. This practice not only saves labor and is of great advantage in time of scarcity of labor, but also enables the farmer to produce live stock at lower cost than when the crops are harvested by hand and machine and then fed to the stock. (See Farmers' Bulletin 1008.)

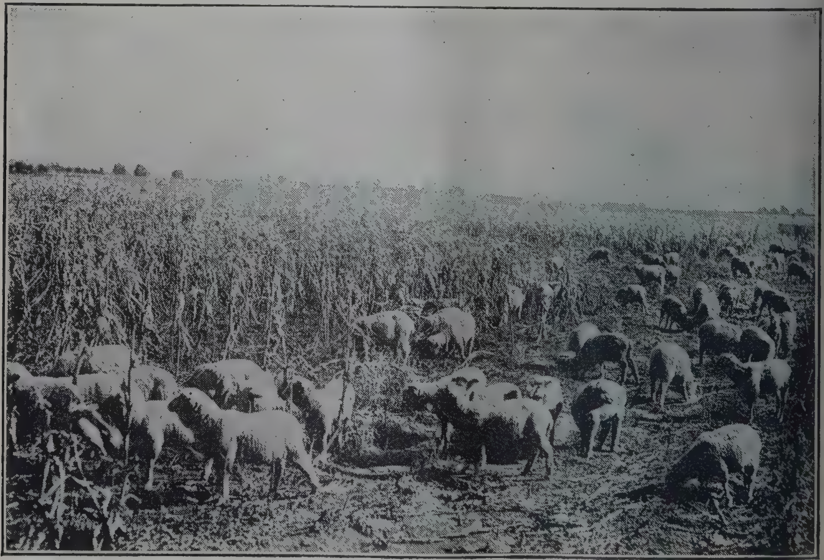


FIG. 38.—The sheep shown above have cleaned up the soy beans which were planted in this corn at the last working and are now beginning on the corn. They were left in the corn until the entire crop was harvested, at which time they were fat and ready for market. (Farmers' Bulletin 1008.)

UTILIZING UNTILLABLE AND WASTE LAND.

. 39.—On many farms are found rough, rocky hillsides or fields or other waste land ot suitable for tillage purposes. These fields can be made to add something to the arm receipts by using them as pasture.

. 40.—Forest growth is profitable on rough, steep, and wet lands, poor soils, and ' waste " corners about the farm. By proper handling, the quantity and quality of he timber, as well as the money returns from woodlands, can be substantially ncreased: (*a*) Mature oak which the farmer has let stand on a piece of very rocky arm land. (*b*) Young slash pine growing rapidly on wet land and of high value for urpentine and pulpwood or fuelwood. If thinned the larger trees will soon yield saw logs.

SIZE OF THE BUSINESS.

The size of the farm business naturally has a direct influence on the amount of the farm income.

The size of the business is usually measured by the number of acres used, the number of animals from which profits may be earned, the number of productive days' work the farm furnishes for men and work animals, and the amount of working capital.

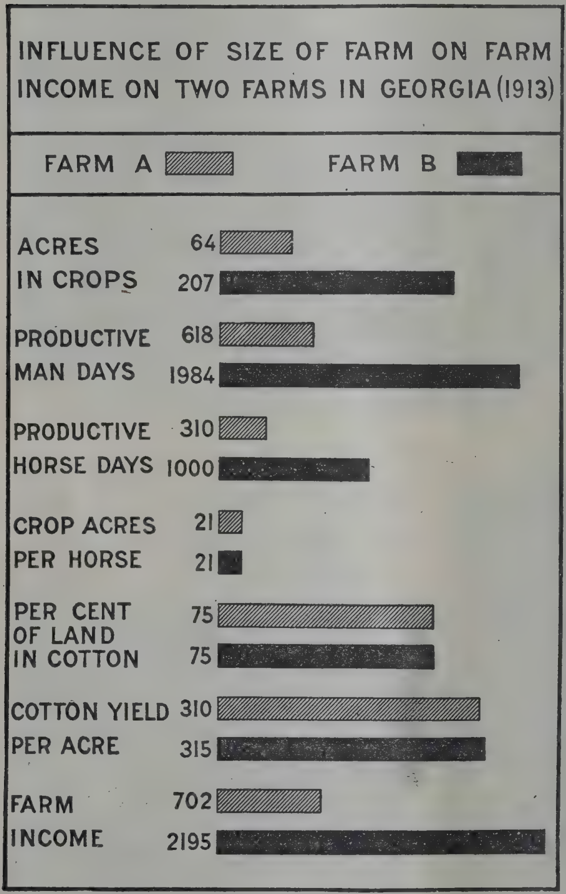


FIG. 41.—Equal in efficiency, but far from equal in farm income.

Figure 41 shows the influence of the size of the farm business as measured by tilled acres and productive days' work per man and per horse on the farm income on two Georgia cotton farms.

The number of tilled acres per work animal, the per cent of land in cotton and the yield of cotton per acre are practically the same for the two farms but farm B has a little more than three times as many tilled acres and furnishes a little more than three times as many productive days' work for man and horse than does farm A.

This same proportion shows directly between the two farm incomes, that of farm B being a little over three times as large as that of farm A.

Studies of large groups of farms in many parts of the country indicate that the farms of larger acreages uniformly earn larger incomes than the smaller farms of the same type.

Figure 42 shows the relation of size of farm to income on 147 vner farms in Sumter County, Ga.

Increasing the size of the farm may result in greater efficiency in e use of labor on the farm. Figure 30 on page 21 shows how the rger farm (C) used its five mules more efficiently on 161 acres than e smaller farm (A) used five mules on 96 acres.

Of course the larger farm does not always have the larger income, ren when the two farms compared are of the same type. For inance, turning back to figure 1, on page 5, it will be seen that the rm with 21 acres has a larger income than the farm with 58 acres. will also be seen that the two farms of 59 acres each have farm inmes larger than either of the farms with 120 tilled acres. This is ecause the quality f business on these maller farms was ufficiently higher to vercome the adantage of more cres on the large arms.

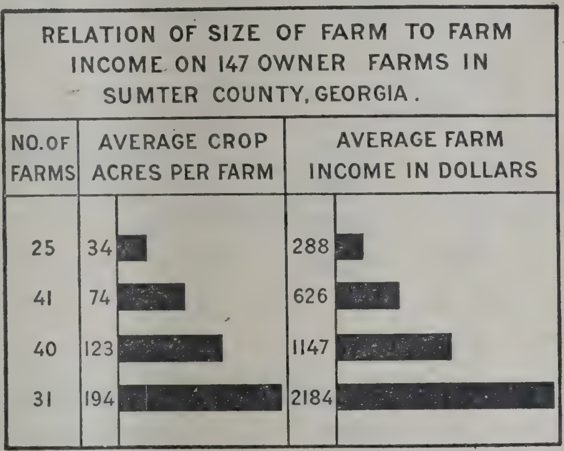


FIG. 42.—The larger the farm, the greater the income. (Figures for 1913.)

A larger income n a larger farm nay not indicate any etter farming. In igure 41, page 28, farm B, though hree times as large, nd having a farm ncome three times s large as farm A, is not farmed any better than the smaller farm. Farmer B has more capital and may have greater skill in handling arge numbers of men and teams.

A large farm may show a larger income than a smaller farm with igher quality of business, simply because the larger farm, with a lower quality of business and a smaller income per acre or per head of productive live stock, has been able so to multiply smaller returns per unit as to exceed the farm income of the more efficiently managed smaller farm. For example, farm B, in figure 3, page 7, made a farm income of $14.50 per acre compared with a farm income of $10.60 per acre of farm B, figure 41, yet the latter had enough acres more than the former to make its total farm income $427 larger.

The size of the business and the farm income may be increased not only by adding to the acres used or to the numbers of productive animals, but also by raising the quality of the management.

ORGANIZATION OF FARM ENTERPRISES.

The relation which the principal enterprises bear to each other in magnitude has a strong influence on the efficiency with which the business can be conducted, and therefore on the size of the farm income. (See Fig. 43.) In figure 43 two cotton farms are compared on the basis of organization of the crop land.

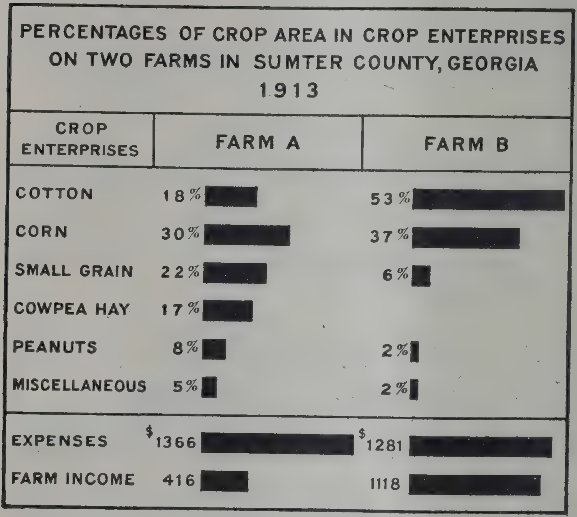


Fig. 43.—A contrast in farm organization.

Farm A.		Farm B.	
Crop acres	94	Crop acres	94
Cotton per acre	325	Cotton per acre	310
Corn per acre	14. 3	Corn per acre	11. 4

The farms have the same amount of crop area, and the yields per acre of the two principal crops, cotton and corn, were somewhat in favor of farm A. The expenses on the two farms were very nearly equal, but farm B had a farm income nearly three times as large as that of farm A, due very largely to a better organization and distribution of the crop enterprises. After providing for the farm needs, most of the remaining crop land was put into cotton, the principal commercial crop of the region.

The operator of farm A sacrificed too much cotton for less valuable crops.

In figure 44 are given the average relative sizes of the crop enterprises on some of the more profitable one to six mule farms in Sumter and Brooks Counties, Ga. It will be seen that farm B (fig. 43) approaches quite closely in organization to the average of the 30 profitable farms in Sumter County.

A marked difference will be noticed in the organization in the two counties. In Sumter County, after making ample provision for the farm needs, the remainder of the land is devoted largely to cotton, the most important commercial enterprise. In Brooks County the soil is thinner and it is necessary to pay particular attention to the maintenance of soil fertility, so a system has been developed which gives a smaller relative acreage to cotton and pays particular attention to the legume feed crops and hays. Besides the regular peanut crop, peanuts are planted between the corn rows on about half the corn area.

To each mule these Brooks County farms carried an average uivalent of three mature cattle and sixteen 200-pound hogs, includ- g two brood sows. Among the important miscellaneous crops on e farms are watermelons, sweet and Irish potatoes, and sugar corn.

It is not intimated that these systems of cropping are the best at could be devised for these farms or for the communities repre- nted, but they were evidently better than the average, in that they elded comparatively high returns for the use of land, working pital and labor.

These systems will change as conditions change. Indeed, the ad- ent of the boll weevil and the high price of hogs has already started Sumter County a ange in the direc- on of the Brooks ounty system.

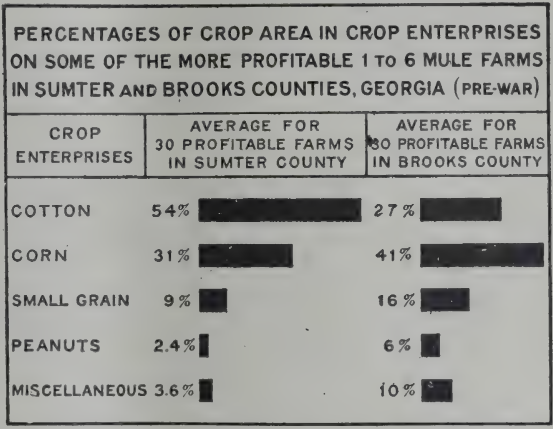


Fig. 44.—Acreage in different crops on profitable southern farms.

The point to be nphasized here is at for each farm mmunity and for ach type and size f farm there are rtain combinations f enterprises that dmit of a more effi- ient and profitable andling of the busi- ess, under average limatic and economic conditions than do any others that have been ied thus far. The efficient adjustment or organization of the farm nterprises along these more profitable lines depends on the follow- g factors:

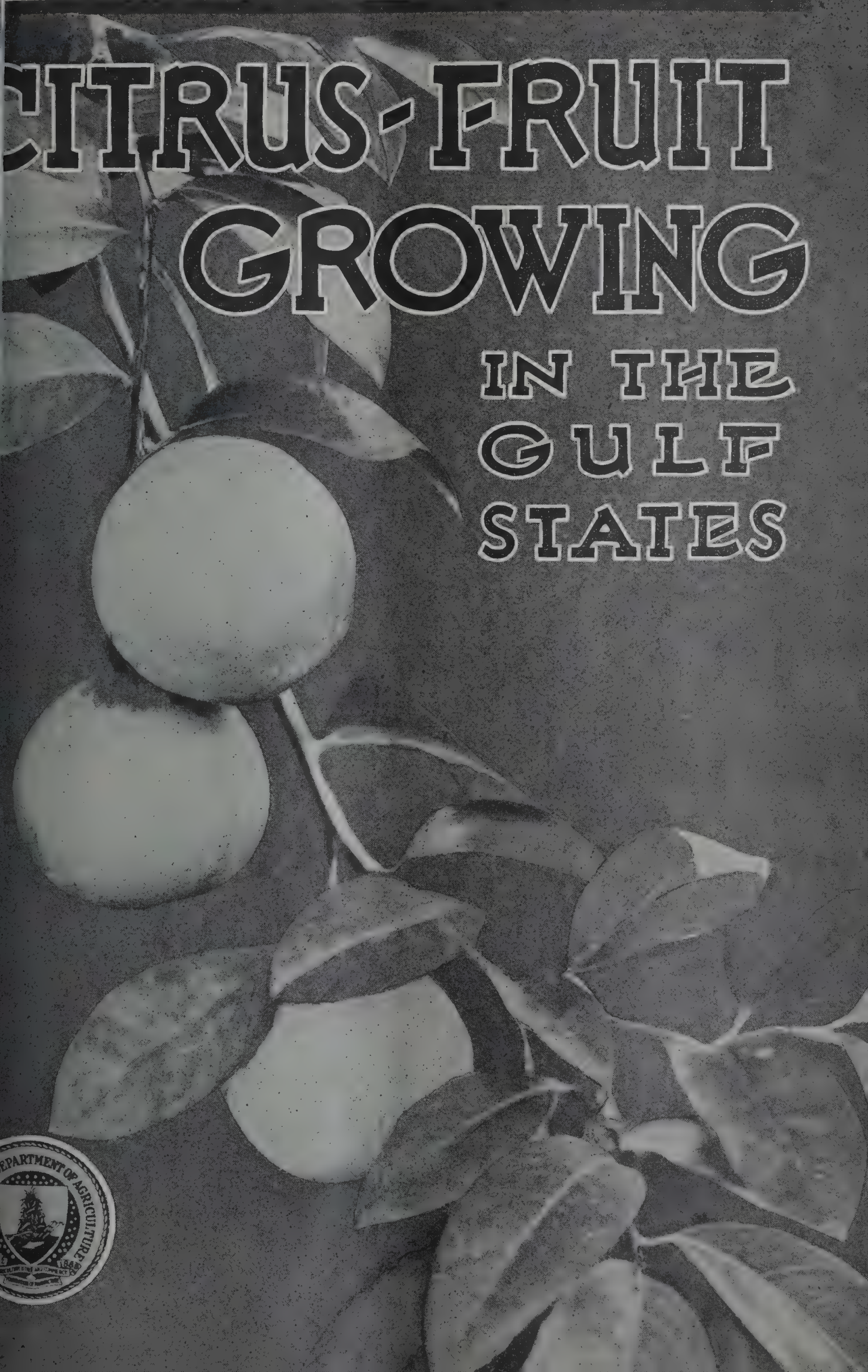
1. The live stock and acreages necessary to supply the family and arm needs.
2. The fertility of the land.
3. The economic importance of enterprises adapted to the region, articularly as to market demand and the relation of prices to returns or labor and material expended.
4. The seasonal labor requirements of the enterprises.
5. The supply of labor and its cost.
6. The topography of the farm.
7. The size of the farm.
8. The advent of injurious insects and plant diseases.

Some of these factors are known to every farmer; some must be eighed in the light of the accumulated experience of the com- unity. All that the farmer needs to know about the others can e gleaned from a well-planned and well-kept set of farm records.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

FARMERS' BULLETIN 1122
NITED STATES DEPARTMENT OF AGRICULTURE

CITRUS-FRUIT GROWING IN THE GULF STATES



THIS BULLETIN contains information on the chief problems encountered by newcomers and prospective growers in starting and maintaining a citrus grove in the Gulf States. The selection of locality and site, choice of varieties, cultural methods, and the business aspects of citrus-fruit growing are among the more important problems considered.

The importance of thorough and careful personal investigation before investing in lands or groves is emphasized, since good and worthless citrus lands are often found side by side. As the selection of the best varieties for planting in each locality is of great importance, the question of variety is considered in some detail.

The growing of citrus fruits is a highly complex business, and both skill and attention to details are requisites for the profitable production of fine fruits.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. September, 1920

CITRUS-FRUIT GROWING IN THE GULF STATES.[1]

E. D. VOSBURY,
Scientific Assistant, Office of Horticultural and Pomological Investigations.

CONTENTS.

ope of the work — 3
story of the Florida citrus industry — 4
story of the citrus industry in the other Gulf States — 5
lection of a locality and site for a grove — 7
nds of citrus fruits for the Gulf States — 11
Varieties of citrus fruits for the Gulf States — 15
Propagation of citrus trees — 20
Grove management — 23
Harvesting and marketing citrus fruits — 42
Costs and profits in citrus growing — 43
Publications on citrus fruits — 45

SCOPE OF THE WORK.

THERE is an increasing demand, especially on the part of new-comers and prospective growers, for information concerning itrus-fruit growing in the Gulf States. While it is not possible in a rief publication of this sort to give complete information regarding uch a complex industry as modern citrus culture, it will be of value o outline some of the general principles as a guide to those interested. brief account is given of the history and development of the indus-ry in Florida and the other Gulf State citrus regions. This is fol-owed by a discussion of the factors involved in the choice of locality nd site, the selection of varieties, cultural methods, the business as-ects of the industry, and other important problems.

As Florida produces by far the most citrus fruits of all the States nder consideration, a more complete discussion is given of the indus-ry in that State than for the other sections. Much of the information elative to Florida, however, will be applicable to the other Gulf tates as well. Whenever marked differences in methods exist, each ocality is considered separately.

---

[1] The writer is indebted to Messrs. H. R. Fulton and J. R. Winston, of the Office of ruit-Disease Investigations, Bureau of Plant Industry, and Mr. W. W. Yothers, Office of ropical and Subtropical Fruit-Insect Investigations, Bureau of Entomology, for the in-rmation contained in the section entitled "Spraying citrus trees."

HISTORY OF THE FLORIDA CITRUS INDUSTRY.

Oranges, grapefruit, and other citrus fruits were first brought t the United States by the Spaniards, who planted them in Florid more than three centuries ago. Prior to 1870 the commercial citru crop of Florida was limited to the output of a few small groves i the northern part of the State. Most of the groves were situate along the banks of the St. Johns and other rivers, as practically th sole means of transportation was by river boats. The methods o culture, harvesting, and shipping were very crude, but in spite o many handicaps the pioneer growers prospered, and after the adven of the railroad lines in the early sixties the industry grew ver rapidly. Most of these early plantings were of orange trees. Grapefruit culture was neglected, and the fruit had little market value unti the late eighties, when it began to grow very rapidly in favor, unti at the present time the grapefruit is becoming a close rival to th orange in commercial importance.

The first severe freeze recorded was in 1835, when orange tree from 40 to 50 years old were killed at St. Augustine and Mandarin No freeze since that time has been so severe.

The second serious check to the growth of the industry occurre in 1886, when a severe freeze ruined most of the orange crop an killed many young trees. In the winter of 1894–5 two disastrou freezes killed most of the trees to the ground and ruined thousand of groves. In 1899 another killing freeze occurred. As a resul of these costly experiences much of the old northern citrus area wa abandoned permanently and the industry was relocated in souther and central Florida. From that date citrus production in Florid increased without any serious check until 1917, when a freeze i February in many sections killed to the ground most of the youn trees, frosted most of the crop, and in some sections cut back th bearing trees severely.

Although the citrus industry has fully recovered from these disasters, the various freezes have taught the growers many valuabl though costly lessons. The importance of selecting grove sites whic are relatively free from frosts has been strongly emphasized, and th advisability of protecting groves by some means of orchard heatin has been demonstrated, particularly in those sections where killin frosts have been experienced. The importance of crop diversity ha also been recognized, and many growers who formerly produce citrus fruits exclusively are now raising live stock, truck, forag crops, and other staple farm produce.

---

[1] Webber, H. J. The two freezes of 1894–95 in Florida and what they teach. U. Dept. Agr. Yearbook, 1895, pp. 159–174, figs. 16–21, pl. 3. 1896.

One-crop farming at best is a gamble, and in case of a severe freeze e man with a number of staple farm crops is much better prepared weather the lean years than the grower who has oranges only. urthermore, in diversified farming the labor, horses, and equipment e more efficiently and economically employed through the year than here nothing but a citrus crop is produced.

As a result of these experiences the Florida citrus industry is now a more stable basis than at any time in the past. Great improve-ents have been made in cultural methods and in the control of sects and diseases. The introduction of modern methods of har-sting, packing, and shipping has stimulated both production and mand by enabling the fruit to be shipped to the most distant arkets with a minimum loss from decay.

Four distinct citrus-growing sections of Florida have been out-ned,[1] as follows:

Northwestern Florida, that part of the State lying west of the ucilla River; eastern Florida, that part between the Aucilla River nd a straight line drawn from the mouth of the St. Johns River Cedar Keys; central Florida, that part of the State between e line referred to above and north of the counties constituting uthern Florida; southern Florida, the counties of Brevard, Dade, onroe, Lee, De Soto, Manatee, St. Lucie, and Palm Beach.

By far the greater portion of the citrus fruits are produced in e central and southern sections of Florida. In the western and stern sections of northern Florida the citrus industry is of rela-vely minor importance, although there are a number of small, olated groves, and in the northwestern part of the State plantings Satsuma oranges have been made in the last few years.

One of the most important factors in raising the standard of trus growing in Florida has been the Florida Citrus Exchange, nonprofit, cooperative marketing organization which includes rowers in all parts of the State. The Florida State Horticultural ociety has also been a valuable agency in promoting the social and usiness relations of the citrus growers.

HISTORY OF THE CITRUS INDUSTRY IN THE OTHER GULF STATES.

In a narrow area on either side of the Mississippi River south f New Orleans, in Louisiana, citrus fruits have been grown for any years. This region has experienced occasional setbacks from rosts and other causes, but citrus fruits are still grown there com-ercially on a small scale. Most of the crop is sold in the New rleans markets.

---

[1] Catalogue of fruits. *In* Proc. 18th Ann. Meeting, Fla. State Hort. Soc., 1905, pp. xxii. 1905.

Extensive plantings of Satsuma oranges and other citrus fruit have been made in other sections of southern Louisiana. Th losses from killing frosts have been so heavy, however, that mos of these plantings have been abandoned. Many experienced Louisiana growers believe that citrus planting, except in the regio south of New Orleans, should be restricted to small groves in th most frost-free localities. A number of such small groves of Satsuma oranges have been found profitable in the production of frui for the local markets. Usually these groves consist of an acre o two of fruit, planted on protected sites on southern Louisiana farm where general farming is practiced.

The commercial planting of citrus fruits in Texas is now restricted almost entirely to the lower Rio Grande Valley, wher several hundred acres of orange and grapefruit groves are unde irrigation. Considerable loss has been experienced in this sectio from the freezing of young trees, and in some localities the use o strongly alkaline water for irrigation threatens serious damag to the groves. As late as 1918 shipments of citrus fruits from thi section had not reached a car-lot basis, and until the industry passe beyond the experimental stage plantings should be extended wit caution and citrus fruits should be grown as one crop in a schem of general or diversified farming rather than as a single-crop venture

Satsuma oranges and other citrus fruits were at one time extensively planted along the northern Gulf coast section of Texas, particularly in the vicinity of Houston and Beaumont. Many of these plantings were repeatedly killed back by cold, and in the winter of 1916–17 thousands of acres of citrus groves were frozen to the ground and abandoned. On account of unfavorable climatic conditions and other factors, as pointed out by the United States Department of Agriculture in past reports,[1] the Gulf coast of Texas is not in general a promising section for the profitable and conservative development of an extensive citrus industry. Future plantings north of the Rio Grande Valley should be limited to small groves of the hardier sorts of citrus fruits, such as Satsuma oranges and tangerines, planted in the most favorable localities to produce fruit for the home or local markets.

In Alabama the main citrus sections are located in Mobile and Baldwin Counties. In Mississippi there are smaller commercial plantings along the Gulf coast. These plantings consist almost entirely of Satsuma orange trees, although a few round oranges and grapefruit are grown for home use. The industry in this section received a severe check in the heavy freezes of the winter of 1916–17, when hundreds of acres of groves were cut back or killed. As a esult of this freeze and a number of previous freezes, Mississippi nd Alabama growers have come to the same conclusion as the lorida growers, namely, that groves should be located on the most rost-free sites, and for the greatest degree of safety the grower here, s in most other localities, should make citrus culture a part of genral farming rather than a single-crop venture.

---

[1] Agricultural conditions in southern Texas. U. S. Dept. Agr., Bur. Plant Indus. [Misc. Pub.] 457, 8 pp. 1909.

These setbacks and their lessons to the growers have placed the atsuma orange industry in Alabama and Mississippi on a much afer basis than in earlier years. A cooperative association of the rowers, known as the Alabama Citrus Exchange, has been of much ssistance in the development of the marketing end of the industry n that section. The Gulf Coast Horticultural Society fills the same lace with reference to the citrus industry in northwestern Florida, outhern Alabama, and southern Mississippi as does the Florida State Horticultural Society for the main citrus sections of Florida.

Small home orchards, including the Satsuma and round oranges and occasionally a few lemon and grapefruit trees, are found in many Gulf State sections too cold for larger commercial plantings. A few very small groves have been planted in southern Georgia and on the slands off the coasts of Georgia and South Carolina. In these colder sections citrus plantings are confined to trees budded on trifoliate-orange stock and grown in sheltered dooryards and similar spots where they can be protected in winter.

The principal areas within which citrus fruits are grown are shown in figure 1.

SELECTION OF A LOCALITY AND SITE FOR A GROVE.

CHOOSING A GENERAL LOCALITY.

The first problem to be solved by the prospective citrus grower is the selection of a general locality and a particular site in that locality for planting the grove. It is quite impossible to answer the questions so frequently asked regarding the advantages of one locality compared with another. Each section has its particular advantages and drawbacks, and one investor will prefer conditions to which another would strongly object. Prospective growers should therefore make as thorough and careful an investigation as possible, especially when the amount of capital available is limited. The various State agricultural experiment stations will gladly advise prospective settlers as to sites, and in many cases they can put newcomers in touch with experienced, successful citrus growers from whom valuable information can be secured. It is inadvisable to purchase lands for agricultural purposes without first making a careful personal investigation of the locality, especially when such a large investment is involved as is necessary in the development of citrus grove.

The general advantages of any locality for a farm home, includin sanitary conditions, nearness to good schools, neighbors, roads, an other factors, should be fully considered. Due emphasis should b placed on the record of any locality as to damage from killing frost in the past. In general, growers should restrict extensive planting to established and prosperous communities which have a long recor for the extensive and profitable production of high-quality fruit.

It is a great advantage to be located near a shipping point an close to a packing house with a high reputation for the quality of it output. Long wagon hauls are expensive and impair the shipp quality of the fruit. A haul of more than a few miles is such heavy handicap as to bar an otherwise ideal locality from considera tion, especially when the available roads are in poor condition.

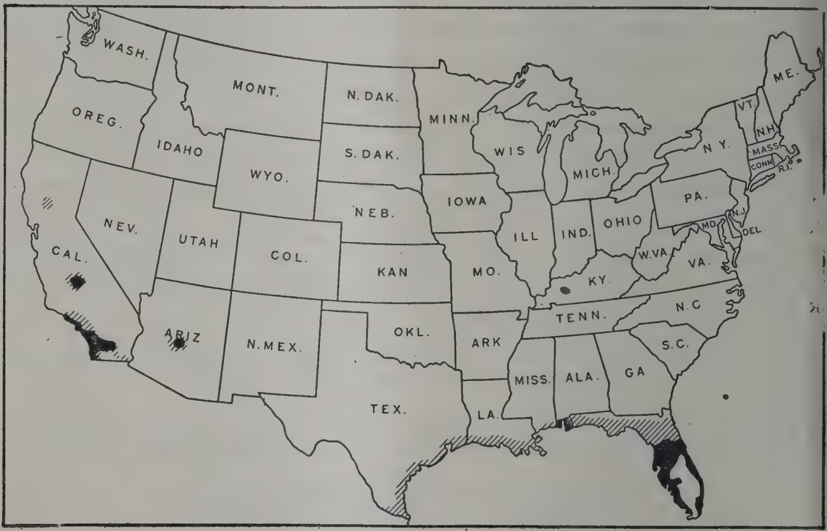


FIG. 1.—Outline map of the United States, showing the principal regions in which citr fruits are grown commercially. The shaded area shows the regions where citr fruits are grown. Heavily shaded areas show important commercial citrus sections.

SELECTION OF A GROVE SITE.

After the general locality has been selected, the question of choos ing a particular site for the grove should be decided.

FROST AND AIR DRAINAGE.

Careful consideration must be given to the liability of a propose site to killing frosts, for it has been strikingly shown in past freeze that the damage from cold varies greatly even in groves a mile o less apart. Florida groves on land elevated even slightly above th urrounding country were much less injured in the freeze of 1917 an adjacent groves situated in valleys or depressions or on other ow-lying ground. It has been shown that cold air drains away from e higher lands and settles in the lower levels and that there may e 5 degrees or more difference in temperature in favor of the levated sites. This protective effect of air drainage was also very arked in the orange sections of Alabama, as well as in the other ulf States, following the freezes of the winter of 1916–17.[1] Groves n low lands and in depressions generally were badly frozen back, hile those on higher lands in the immediate vicinity escaped with uch less injury. One of the Alabama growers remarked that the eezes had had one benefit, "They have shown us where not to ant."

SOIL DRAINAGE.

Land slightly elevated has another great advantage over low and and hollows, aside from that of greater freedom from frost, amely, that of better soil drainage. Good soil drainage is an essenial factor, and land subject to overflow or land where the water able stands less than 3 or 4 feet from the surface at any season of he year should be avoided unless this defect can be remedied by rtificial drainage.

ROST PROTECTION AFFORDED BY LAKES, BAYS, AND OTHER BODIES OF WATER.

Lakes, bays, and other bodies of water may afford valuable proection from frost, particularly when they are of considerable size. his protective influence of water, however, is limited almost enirely to groves on the leeward side of the water bodies and is eldom noticeable for a distance of more than a mile or so from the hore. In the freeze of 1917 groves on the southern shore of Lake popka, Fla., a circular body of water about 25 miles in diamter, suffered very little injury, although groves 2 miles farther outh were severely cut back. In this instance the freezing winds ame from the northwest, and only the groves on the south and outheastern, or leeward, shores received noticeable protection. In e case of very large bodies of water, such as the Gulf of Mexico, e protection afforded is much more extensive.

WINDBREAKS.

Belts of timber, when located on the windward side of a grove, are aluable as windbreaks and often protect the trees from drying as ell as from freezing winds. On the leeward side of the grove such indbreaks are of no value and may actually be a detriment, checking air drainage. Where the grove is entirely surrounded by dens woods it is often advisable to cut one or more lanes through th woods on the leeward side of the grove so as to permit the cold ai to drain away.

---

[1] Winberg, O. F. E., Starcher, G. C., and Isbell, C. L. Report on freeze injury to trus trees for 1916 and 1917, with notes on orange culture in south Alabama. Ala. Agr. xpt. Sta. Bul. 199, 26 pp., 7 pl. 1918.

SOILS.

Although citrus trees will grow in many soils, they are much bette adapted to some soils than to others, and the selection of the prope kind of soil should be carefully considered. In Florida the soi types used most extensively for citrus groves are known as high pine flatwoods, high hammock, and low hammock.

Low-hammock soils in their virgin state support a luxurian growth of cabbage palmettos, oaks, bays, or other hardwood trees They are the richest of the four soil types in fertility and humus and while expensive to clear they make splendid citrus soils if wel drained.

High-hammock lands have a higher elevation and a more ope growth of hardwood trees than low-hammock lands. They are fertile and well drained, and many growers consider them the mos desirable of all citrus soils. In general, these hammock soils requir much less fertilizer than the lighter pineland soils.

Most of the recent citrus plantings in Florida have been made o high pineland. Three grades of high pineland are recognized. Th best grade is characterized by large straight-growing pines wit occasional oaks, hickories, or other hardwood trees. The soil is sandy loam, fairly rich in humus, and is underlain with a clay subsoi at a depth of 6 feet or less. In second-grade pinelands the pine tree are smaller and there are few or no hardwoods, while the subsoil i farther from the surface. In the third or poorer grade the pines ar still smaller and scrubbier and the clay subsoil far below the surfac soil.

The high pinelands as a class are well drained and relatively inexpensive to clear. The better grades, while not high in fertility, mak good citrus lands if the humus supply is adequately maintained.

Flatwoods pineland is usually low and uniform in elevation. Th soil is often rich in humus, and where such land can be adequatel drained it may be well adapted to citrus culture. Many flatwood areas, however, are poorly drained or subject to overflow. Frequently they are underlain with a layer of hardpan. Such soils ar of very inferior value for citrus trees and should be avoided. A dense growth of saw palmettos in pine flatwoods is frequently a indication of an undesirable hardpan or subsoil.

The several soil types described for Florida are also found in som of the other Gulf States. In Louisiana, south of New Orleans, th soil is of a rich alluvial character and is frequently subject to over-v from the Mississippi River, so that high dikes are often neces- y to keep the water from injuring the groves.

n the Rio Grande Valley of Texas the soils are of a silty forma- n. In southern Alabama and Mississippi well-drained hammock ds and the more fertile type of pinelands are preferred for citrus ntings. The best types contain considerable humus and have a y subsoil within 2 or 3 feet of the surface.

KINDS OF CITRUS FRUITS FOR THE GULF STATES.

RELATIVE IMPORTANCE OF THE CITRUS FRUITS GROWN.

After the locality and site have been selected, the next problem is at of choosing the best kinds and varieties of citrus trees for plant- g. The most important citrus fruit grown in Florida is the common und sweet orange, which is pro- uced in all the citrus sections of the tate. Round oranges are also rown commercially in the Delta egion of New Orleans.

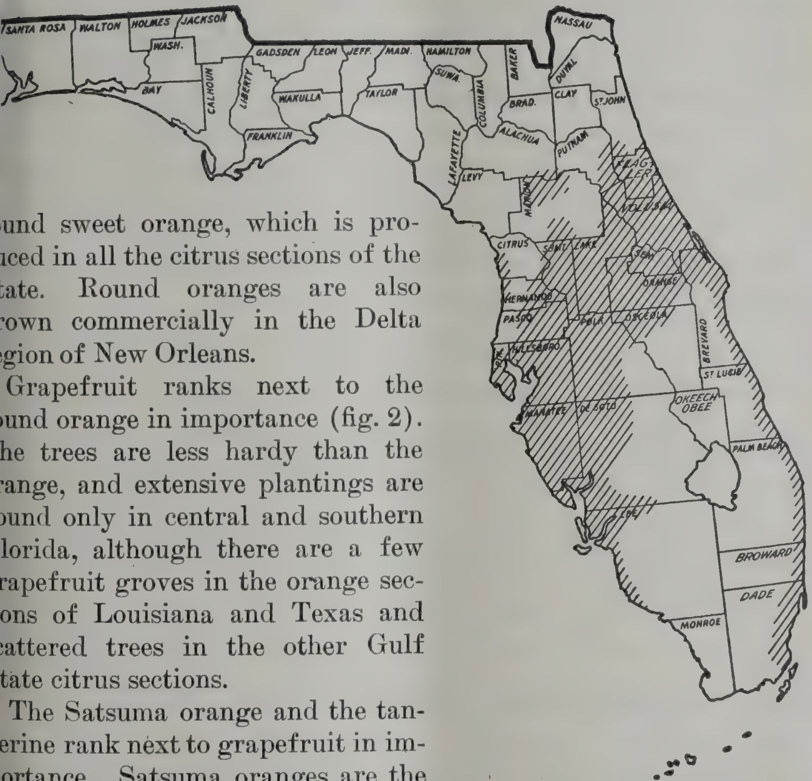


Fig. 2.—Map of Florida, showing, by shading, the location of the principal regions within which round oranges and grapefruit are grown.

Grapefruit ranks next to the ound orange in importance (fig. 2). he trees are less hardy than the range, and extensive plantings are ound only in central and southern lorida, although there are a few rapefruit groves in the orange sec- ons of Louisiana and Texas and attered trees in the other Gulf tate citrus sections.

The Satsuma orange and the tan- erine rank next to grapefruit in im- ortance. Satsuma oranges are the ost important of the citrus fruits rown in northwestern Florida, outhern Mississippi, southern Ala- ama, and other sections too cold or round oranges and grapefruit. Although the Satsuma orange hen budded on trifoliate stock is considerably hardier than the round range, it is by no means “ frost proof,” and it should be planted only on the more frost-free sites of the sections where it has already pro successful. In southern Florida the Satsuma orange is of unsa factory quality and is seldom planted. The tangerine is grown m extensively in southern and central Florida, but it is also raised in the citrus sections of the Gulf States. It is almost or quite as ha as the Satsuma orange when grown on the same stock.

Lemons are much more tender than oranges and should be plan commercially only in the warmest sections. Prior to the great fre of 1895, which killed most of the trees, many thousands of boxes lemons were shipped from Florida, but now there are no large co mercial lemon groves in the Gulf States, although numerous lem trees are grown in dooryards throughout southern Florida. It possible that lemon culture could be extended in the most protect regions of extreme southern Florida, such as the coastal regions sou of Fort Pierce and Punta Gorda, to the point of producing sufficie fruit for the local markets.

Limes are still more tender than lemons, and their commerc culture is restricted to the Florida keys and to a few of the be protected localities of southern Florida. For home use limes often grown in sheltered dooryards much farther north. The dema for limes is much greater than the supply, and their culture in fav able localities of southern Florida, such as on the keys and in t coastal regions mentioned, promises good returns.

The kumquat is a small tree or bush which bears abundant rou or egg-shaped fruit the size of small plums. While no longer co sidered a true citrus, the kumquat is closely related botanically the genus Citrus. It is hardy, makes a handsome ornamental, a is popular as a dooryard shrub in all the Gulf coast sections. T fruit is grown to a small extent commercially and shipped to t North as fancy fruit for the holiday trade. In the vicinity of Mobi and in a few other sections kumquats are grown for marmala and other preserves.

Citrons, shaddocks, and a number of other citrus fruits are occ sionally grown as ornamentals in Florida and the Gulf coast sectio

TABLE I.—*Principal citrus fruits grown in Florida during the season of 1917–*

Fruit.	Bearing trees.	Nonbearing trees.	Boxes.	Value.
Orange	3,567,072	2,452,426	5,177,081	$9,899,1
Grapefruit	1,893,086	1,493,193	2,566,608	4,770,1
Limes	75,950	....	15,882	53,1
Lemons	17,098	15,220	9,258	29,2

Table I, from the fifteenth biennial report of the Florida Stat Department of Agriculture, shows the relative importance of th ncipal citrus fruits grown in that State during the season of 7–18.

'able II shows the estimated citrus acreage in Texas in 1918.[1]

Table II.—*Estimated acreage of citrus fruit trees in Texas in 1918.*

Kind of trees.	In bearing.	Not bearing.	Total.
uma oranges	400	1,000	1,400
pefruit	400	2,200	2,600
nd oranges	500	2,200	2,700
ions	50	50	100
cellaneous	13	300	313
Grand total	1,363	5,750	7,113

An actual survey of the orchards in Mobile and Baldwin Counties, nprising the chief citrus area of Alabama, made by Dr. O. F. E. inberg, of Silverhill, Ala., shows the number of Satsuma orange es given in Table III.[2]

ble III.—*Number and location of Satsuma orange trees in Alabama in 1918.*

Location.	Bearing trees.	Young trees.	Total.
bile County	480,899	212,484	693,383
dwin County	196,672	52,710	249,382
Total	677,571	265,194	942,765

The citrus plantings in Mississippi, consisting almost entirely of tsuma oranges, were estimated in 1919 as slightly less than those Alabama.

In November, 1915, the estimated citrus acreage in Louisiana was 000 acres, both bearing and nonbearing.[3] Owing to the extremely d winter experienced in 1917, this acreage has been reduced one-lf or more.

IMPORTANCE OF STANDARD VARIETIES.

The early citrus groves in Florida, Louisiana, and other Gulf ates consisted almost entirely of seedling trees. Many of these old edling groves still remain, but they are fast disappearing. Seedgs are no longer planted in Florida, although they are quite freently set in some of the other citrus sections.

---

[1] Table II was furnished by Ed. L. Ayers, State nursery inspector, Houston, Tex.

[2] Letter of Dr. Winberg, dated May 18, 1918.

[3] Estimate furnished in November, 1915, by the Louisiana Citrus Growers' Association, w Orleans, La.

In the early days of citrus growing in Florida there were one o more seedling orange trees in each community locally famous fo superior fruit. Bud wood was taken from such trees and a larg number of varieties were thus named and planted. Largely as result of the great number of varieties grown, the citrus output o Florida has been much less uniform in appearance and quality tha that of California, where but two varieties of oranges, the Washington Navel and the Valencia, are extensively grown. It has long bee recognized in Florida that of the many varieties available a fe should be chosen which can be developed as typical standard commercial sorts and the other less desirable ones eliminated.

As a result of this demand for standardization, a committee o prominent growers and nurserymen was appointed by the 191 Citrus Seminar at Gainesville, Fla., to recommend a short list o selected varieties. The orange varieties chosen as standard were th Parson (*Parson Brown*), Homosassa, Valencia, Pineapple, and Lu (*Lue Gim Gong*). No action was taken for grapefruit.

In making up his planting list the grower should limit his choic to two or three of the standard varieties of oranges best suited to hi special requirements of soil, season, and situation. For each localit there are certain varieties which are best adapted. The Parso orange, for example, matures earlier and colors up more fully i the hammock sections of north-central Florida than in localitie farther south. The Valencia variety, on the other hand, is less desirable for northern Florida, as, on account of its late season o ripening, crops are frequently lost by frosts. The grower shoul take into careful consideration the matter of varietal adaptability before making out his planting list. The same course should be take with grapefruit, although there is less varietal distinction wit grapefruit than with oranges.

In southern and central Florida many experienced growers diversify their citrus plantings and are setting out two or three standard varieties of oranges, three or four of grapefruit, and one o tangerines. A few growers are planting oranges or grapefruit, o even tangerines, exclusively, but it is believed that the practice o growing some of each kind will be the safest and most profitable i the long run. In the colder citrus sections there is less opportunit for such diversity, as the choice must be limited to the hardier sorts

HOME-GROWN VARIETIES.

Every home in the citrus region of the Gulf States should have it own supply of fruit from a small grove or dooryard planting. With a little care the trees can be made to give returns in pleasure and i good fruit far exceeding their cost.

For the home orchard a much wider choice of varieties is possible nd desirable than for the commercial grove. The ideal to work for n planning the home planting is a succession of high-quality fruit hroughout as long a season as possible. Very often fruits too tender for commercial planting in the locality can be successfully grown in he dooryard by giving them some winter protection.

VARIETIES OF CITRUS FRUITS FOR THE GULF STATES.

VARIETIES OF ROUND ORANGES.

The Parson (*Parson Brown*) is the earliest commercial variety grown in Florida. Its season is from early October to November, and the fruit is often sweet enough to ship while the skin still shows considerable green color. The fruit is medium in size and oblong in form, with a fine-textured peel. The dessert quality is fair to good when grown under the most favorable conditions. It does best when grown on sour-orange stock in hammock soil, while on rough-lemon stock, when planted in light soil, it is usually dry and poor. Many growers in northern Florida and in other colder citrus sections plant the Parson because it matures before the season of dangerous frosts. Early fruit of other varieties is often shipped and labeled "Parson Brown," but this practice is discredited by all reputable growers. The Parson, while not an ideal sort, is the best known and most widely planted early variety.

The Homosassa variety matures from late November to February. The fruit is round, somewhat flattened, and medium to large in size. The appearance, dessert quality, and shipping quality are excellent. The trees are regular and prolific bearers when given good care. Those who have grown the Homosassa consider it a profitable variety, and it will doubtless be more widely planted in the future, as it replaces in season the old seedling trees now rapidly dying out.

The Pineapple is the leading midseason variety, maturing from late December to early March. It is variable in shape, medium to large in size, with a thin tough skin and numerous seeds. It is a good shipper and has high dessert quality when well grown. The tree is prolific and vigorous. The fruit often has a distinct pineapple aroma when mature, from which characteristic the name was doubtless derived. (Fig. 3.)

The Valencia, formerly known in Florida as "Hart's Late" and also as "Tardiff," is the latest standard variety grown. The fruit is slightly oval in shape, of good size, and has a very smooth, tough peel. It ripens in March and April, frequently hanging on the trees late into May.

The Lue (*Lue Gim Gong*) is a late variety of recent origin. It is very similar to the Valencia in size, shape, and other characteristics, but it is thought that the fruit will hang on the trees even later than that variety. The Lue has been planted rather heavily in Florida during recent years.

In addition to the standard varieties mentioned, several other oranges are frequently grown in Florida. The various blood varieties, including the Ruby, Maltese, and St. Michael, are often grown commercially. Although somewhat lacking in vigor, the blood oranges are frequently profitable when grown on fairly strong soils. They are of highest dessert quality and usually bring a premium over other varieties when shipped as fancy fruit. They are especially recommended for home plantings.

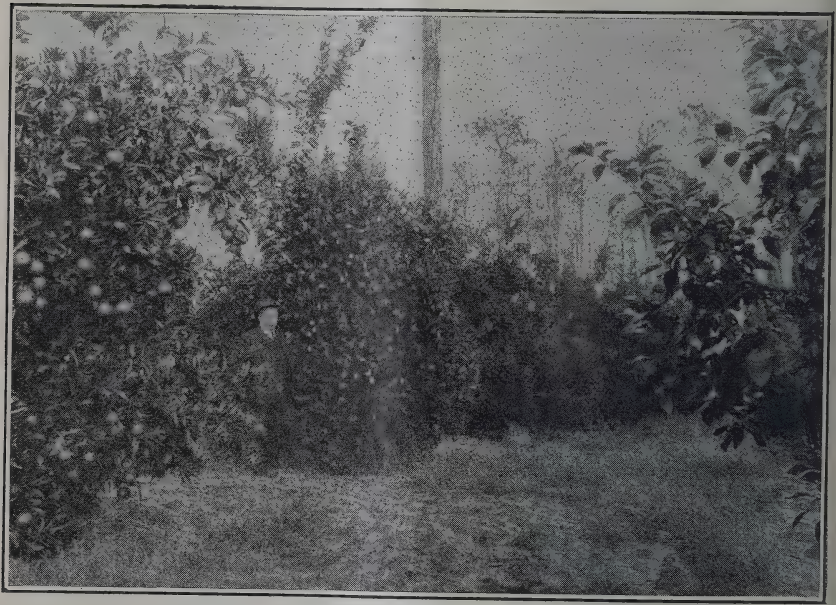


FIG. 3.—Grove of oranges of the Pineapple variety at Dunedin, Fla.

In Louisiana much of the orange crop is picked from seedling trees and shipped as "Louisiana Sweets" or "Creole" oranges. While much of this seedling crop is of high dessert quality, most Louisiana growers now believe that a more uniform and profitable crop can be secured by substituting standard varieties for these miscellaneous sorts. Consequently, recent plantings in Louisiana are largely of the standard Florida varieties, such as the Pineapple and the Parson. Washington Navel oranges on trifoliate-orange stock are grown profitably by some citrus growers in the lower Mississippi Delta section.

In the lower Rio Grande Valley of Texas the more common varie- es are the Pineapple and Valencia. In southern Mississippi and labama very few round oranges are now planted commercially.

GRAPEFRUIT VARIETIES.

Most grapefruit varieties are less distinct in their characteristics han oranges. A large part of the Florida crop is produced on udded trees of unnamed local sorts. This fruit, together with the roduct of seedling trees, is popularly designated as "Florida com- on." The more recent plantings, however, are largely confined to he standard named sorts.

The Hall is a midseason variety maturing in February and March. he dessert quality is good and the trees are prolific. The fruit is requently borne in clusters, and the variety is often known as ilver Cluster.

The Walters is also a midseason variety which is picked in Feb- uary and March, and sometimes later. The dessert quality is ex- ellent, although it is sometimes objectionably seedy. The trees re vigorous and prolific. The Walters variety is very similar to he Hall, and they are frequently regarded as identical.

The Marsh (*Marsh Seedless*) variety matures at the same season s the Walters. The dessert quality is good, although the fruit acks somewhat the characteristic bitter principle of most grapefruit. he fruit is seedless, or nearly so, and this quality is considered of uch value.

The Duncan is the standard late-season variety. It matures in lorida from April to May and can sometimes be left on the trees ntil early June. The dessert quality is excellent, and the trees are igorous growers, good bearers, and somewhat hardier than other rapefruit varieties.

The McCarthy is another late variety of good dessert quality. The trees are vigorous and prolific. The fruit is borne singly rather han in clusters, as is the case with most other grapefruit varieties.

The Davis (*Davis Seedless*) is a seedless variety which has been uite extensively planted in Dade County, Fla., during the last few years. It has not yet been fully tested, but is considered a promis- ng variety for trial.

The Triumph is one of the earliest of grapefruit varieties, fre- quently maturing in December. On account of its extreme seediness and small size, however, it can not be recommended for commercial planting, although it is worthy of a place in the home grove.

In the citrus sections of the Gulf States, aside from those in Florida, the favorite grapefruit varieties are the Duncan, Marsh, and Walters. The Duncan is well adapted for the colder sections where grapefruit is grown, as the tree is somewhat hardier than the other standard sorts.

VARIETIES OF KID-GLOVE ORANGES.

Because of the ease with which the skin may be separated from the pulp, the tangerine, the Satsuma, and the mandarin are popularly known as kid-glove oranges.

The Satsuma was formerly considered a single distinct variety, but recent investigations indicate that at least six varieties are grown in Japan. Three of these appear to have been introduced and planted in the United States,[1] of which the Owari and Ikeda are the most important. The Owari is a flat thin-skinned fruit of high dessert quality. The Ikeda is more spherical in shape, the skin is coarser in texture, and the season is about a month later than the Owari. The Zairai variety appears to have been planted commercially to some extent in southern Alabama, but it is of doubtful value, and its propagation is being discontinued. Only the Ikeda and Owari can be recommended for future plantings. Trees of all of these varieties of Satsumas should be planted only on trifoliate-orange stock.[2]

The tangerine ranks with the Satsuma as the most important of the kid-glove oranges. The Dancy is the only variety of tangerine grown commercially. Its season is December to March, while the Satsuma varieties mature from October to November.

The King, a large-fruited rough-skinned variety of the kid-glove sort, is grown occasionally as a fancy fruit. It is excellent in dessert quality as grown on the hammock soils of the Indian River and other heavy Florida soils, but on the light soils of southern Florida it is usually of inferior quality.

The Temple is a new variety of the kid-glove type, recently brought to light at Winter Park, Fla. Many growers are planting a few trees of it for trial in various sections of Florida.

LEMON VARIETIES.

Lemons can be grown commercially only in the warm sections of Florida, as the trees may be frosted where the temperature falls below 28° F.

---

[1] Tanaka, Tyozaburo. Varieties of the Satsuma orange group in Japan. U. S. Dept. Agr., Bur. Plant Indus., Off. Crop Physiol. and Breeding Invest. Cir. 5, 10 p., 2 fig. 1918.

Scott, L. B. Varieties of the Satsuma orange group in the United States. U. S. Dept. Agr., Bur Plant Indus., Off. Hort and Pom. Invest. Cir. 1, 7 p. 1918.

[2] Swingle, W. T. Tne limitation of the Satsuma orange to trifoliate-orange stock. U. S. Dept. Agr., Bur. Plant Indus. Cir. 46, 10 p., 6 fig., 1 pl. 1909.

The Lisbon is a favorite variety. In favorable locations the tree is a vigorous grower and usually prolific. Most of the crop matures during the winter months.

The Villafranca is perhaps the most commonly planted of the lemon varieties in Florida. The tree is a vigorous grower, with few thorns, and is usually productive.

The Ponderosa is a valuable variety for the home grove. It is an extremely large sort, the fruits often weighing 2 pounds.

LIME VARIETIES.

The Florida lime crop is gathered almost entirely from seedling trees grown on the keys and in other tropical regions of southern Florida. The fruits of these seedling trees are quite variable in size and shape and are known commercially as Mexican or key limes. Some ripen every month in the year, but the main crop is harvested in the summer. The propagation of the best types by budding would doubtless lead to the production of larger and finer crops than are secured from the seedling trees commonly planted. (Fig. 4.)

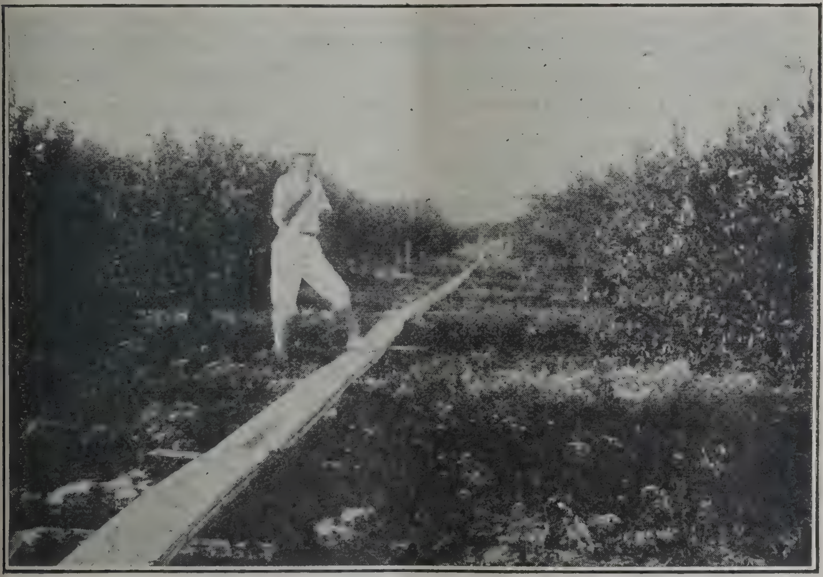


FIG. 4.—A well cared for lime grove at Upper Metacombe Key, Fla.

The Tahiti variety is a budded sort that has been planted recently in southern Florida. It is a somewhat stronger grower and a trifle more hardy than the Mexican seedling limes. The tree is vigorous and usually is a prolific bearer. The fruit is similar in size and appearance to a small lemon. It is of excellent quality for home use and may eventually become of commercial importance, although at present the northern trade prefers the smaller key limes.

KUMQUAT VARIETIES.

The varieties of kumquats grown are the Nagami and Marumi. The Marumi bears small spherical fruits, while the Nagami bears larger oval-shaped fruits and is preferred to the Marumi for all commercial planting.

The Meiwa variety recently introduced is of the highest quality for eating in the fresh state. In size it resembles the Nagami, but it is more nearly spherical in shape.

NEW VARIETIES OF CITRUS FRUITS.

A number of interesting new fruits have been originated by the crossing of various citrus parents.[1] Among the most promising of these new fruits is the tangelo, a hybrid of the tangerine and grapefruit; the limequat, a hardy cross between the lime and kumquat; and the citrange, a hybrid of the sweet orange and trifoliate orange, which is of considerable value as a hardy substitute for the lemon.

New varieties of citrus fruits originating as chance seedlings or bud sports or brought to light by foreign exploration are claiming attention from time to time. Although they ought to be tested, such new sorts should not be exclusively planted until they have demonstrated by their behavior in a practical test for each locality and soil type that they are superior to existing standard varieties in some leading characteristic, such as season, dessert, or shipping quality, or hardiness.

PROPAGATION OF CITRUS TREES.

CITRUS STOCKS.

Citrus trees for planting are usually budded on sour-orange, rough-lemon, and other seedling stocks. The problem of selecting the best stock is of great importance, for in case an unsuitable stock is used the value of the grove may be permanently impaired. Sweet-orange seedling stocks were formerly used very extensively, but as they have been found very susceptible to foot-rot they are now seldom planted.

The sour orange, a hardy species of citrus, which is frequently found growing wild in Florida forests, is the leading stock in Florida as well as in California and most of the citrus-growing regions of the world. It is vigorous and resistant to foot-rot, and the trees produce thin-skinned fruit of fine quality which holds on the branches late in the season. In Florida sour-orange seedlings are the favorite stocks for hammock and flatwoods soils as well as the best grade of pineland. Most growers prefer sour-orange stock wherever soil conditions permit its use.

---

[1] Swingle, W. T., and Robinson, T. R. Tangelos: What they are. The value in Florida of the Sampson and Thornton tangelos. U. S. Dept. Agr., Bur. Plant Indus., Crop Physiol. and Breeding Invest. [Cir.] 4, 3 p. 1918.

On light, dry, sandy soils in southern Florida, where sour-orange stock lacks thrift, rough-lemon stock, a vigorous-growing species of citrus related to the common lemon of commerce, is used. Trees on rough-lemon stocks make a very vigorous growth and on very light soils are easier to care for and require less fertilizer than trees on sour-orange roots. Rough-lemon stocks are tender and not sufficiently hardy for Gulf State sections colder than southern and central Florida. Under favorable conditions trees on rough-lemon stock usually are vigorous and productive, but it is claimed by many growers that the life of such trees is shorter than on some other stocks. The fruit produced by trees on rough-lemon stock, while often good in dessert quality, is frequently inferior to that grown on sour orange, and it can not be held on the tree so late in the season. The Parson variety of orange is seldom successfully grown on rough-lemon stock.

Grapefruit seedlings have been used as stocks to a limited extent in southern Florida. They are too tender for the colder sections of the State. This stock is more vigorous in growth than the sour orange, but less vigorous than the rough lemon. It is best adapted to moist soils well supplied with humus. As grapefruit seedling stocks are less hardy and less resistant to disease than sour-orange stocks, the latter are generally more satisfactory.

The trifoliate orange, formerly known as *Citrus trifoliata*, is the hardiest stock for citrus fruits in common use. It is deciduous, shedding its leaves, and has a distinct dormant season in the winter. This dormancy has the effect of checking the winter wood growth of varieties budded on it, causing them to be less susceptible to low temperatures. For this reason trifoliate-orange seedlings are much used as stocks in the colder sections of the Gulf States. They are rarely desirable as stocks in southern and central Florida and have given unsatisfactory results in the Rio Grande Valley section of Texas.

The trifoliate-orange stock is best adapted to rich moist soils and is unsuited to light dry soils. It is particularly well adapted to sandy loam soils with a clay subsoil. On the proper soils it produces thin-skinned fruit of high dessert quality. It has a tendency to dwarf the growth of the tree budded on it. In the lower Mississippi Delta, Washington Navel oranges are frequently budded on trifoliate-orange stock, and while the growth is less vigorous in that locality they are more prolific than when budded on sour-orange stocks.

Lemon and lime seedlings are occasionally used as citrus stocks, but are too tender for general planting.

SELECTION OF BUD WOOD.

The source of bud wood used in propagation is an important consideration.

Investigations conducted in California by the United States Department of Agriculture have shown that there is a great degree of variation within the standard citrus varieties grown in that State. When these variations of trees or fruit are very marked they are known as strains. Each strain, while retaining the general characteristics common to the variety, has clear-cut differences, either in character of fruit, foliage, habit of tree growth, or production of fruit, so that it can be easily distinguished from other strains of the same variety. Furthermore, the trees of some strains are more prolific and bear much finer fruit than other strains of the same variety.

These investigations have also shown that trees propagated with selected buds from parent trees of these best strains perpetuate the characteristics of these desirable strains and come into bearing earlier and bear heavier and more uniform crops than trees propagated from buds which are not so carefully selected.[1]

Similar differences have been found to exist in the various varieties of citrus fruits grown in the Gulf States. In purchasing citrus trees for planting, growers should ascertain that they have at least been budded from trees which are true to the varietal name and, if possible, from trees which have a reputation for producing large quantities of fine fruit.

Growers and nurserymen interested in the methods of securing records from parent trees and in the subject of bud selection in general can secure detailed information by writing to the Office of Horticultural and Pomological Investigations, Bureau of Plant Industry, United States Department of Agriculture, or by requesting from the Division of Publications, United States Department of Agriculture, Farmers' Bulletin 794, entitled "Citrus-Fruit Improvement: How to Secure and Use Tree-Performance Records."

---

[1] Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus-fruit improvement: A study of bud variation in the Washington Navel orange. U. S. Dept. Agr. Bul. 623, 146 p., 16 fig., 19 pl. 1918.

——— ——— ——— Citrus-fruit improvement: A study of bud variation in the Valencia orange. U. S. Dept. Agr. Bul. 624, 120 p., 9 fig., 14 pl. 1918.

——— ——— ——— Citrus-fruit improvement: A study of bud variation in the Marsh grapefruit. U. S. Dept. Agr. Bul. 697, 112 p., 14 fig., 11 pl. 1918.

——— ——— ——— and Dyer, C. L. Citrus-fruit improvement: A study of bud variation in the Lisbon lemon. U. S. Dept. Agr. Bul. 815, 70 p., 14 fig., 8 pl. 1920.

NURSERY METHODS.

Citrus trees for planting are usually purchased from commercial nurseries, and few growers to-day propagate their own trees. Only a brief outline of nursery methods will therefore be given here. Growers who desire further information on budding, grafting, and other nursery methods can obtain it from Farmers' Bulletin 539.[1]

Seeds of sour-orange, rough-lemon, and other citrus fruits used as stocks are extracted from the fruits and sown in well-prepared seed beds. This sowing is usually done in December and January except in the case of trifoliate-orange seeds, which are more commonly sown in September and October. The seeds are sown in rows about 2 feet apart, and the young seedlings are well fertilized and cultivated until they are large enough for transplanting. When the seedlings are 1 year old and 6 to 15 inches high or when they are 2 years old and 15 to 24 inches high, they are transplanted to nursery rows. These rows are about 4 feet apart, with the trees a foot or more apart in the rows. After one or two seasons in the nursery row the seedlings will measure half an inch in diameter at the crown, and they are then ready for budding.

Budding may be done at any season when the bark slips readily. The ordinary shield-bud method is used in much the same way as with apples and pears. Waxed cloth is commonly used for wrapping the buds. In the spring the seedling tops are cut away, and the growing bud shoots are tied and staked.

When the buds have made a growth of about 30 inches they are pinched back and thus made to branch. The budded trees are ready for planting in the permanent grove when 1 year old, although they are often left in the nursery row and sold when 2 or 3 years old. When thrifty and well grown, 1-year-old buds, i. e., trees that have made one season's growth in the nursery from the bud, are quite as satisfactory as older trees and are usually less expensive.

GROVE MANAGEMENT.

PLANTING THE GROVE.

Clearing.—Before planting, the land should be thoroughly cleared of all native growth. Occasionally some of the larger trees are left standing in order to save the expense of clearing or as shelter trees to protect the young groves from frost and sun (fig. 5). Such trees left in the grove, however, rob the young trees of water and plant food and seriously interfere with the ease of cultivation. Except in the extreme northern citrus regions where frost protection is of vital importance, it will be found a cheaper and much more satisfactory practice in the end to remove all the native growth and thoroughly clear the land before the grove is planted. After clearing, the land should be plowed moderately deep, harrowed and leveled, and the soil put in as good tilth as possible. It is usually advisable to fence the land as a protection from live stock.

---

[1] Rolfs, P. H. Propagation of citrus trees in the Gulf States. U. S. Dept. Agr., Farmers' Bul. 539, 16 p., 9 fig. 1913. For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.; price, 5 cents.

On rich low ground an application of lime is often made after plowing, at the rate of 1,000 pounds of slaked lime to the acre. Ground limestone may be used instead, at the rate of 1 ton to the acre, applied a year or more before the trees are set. However, lime is of doubtful value to citrus trees in Florida, and it should not be used in large quantities, especially on light soils.

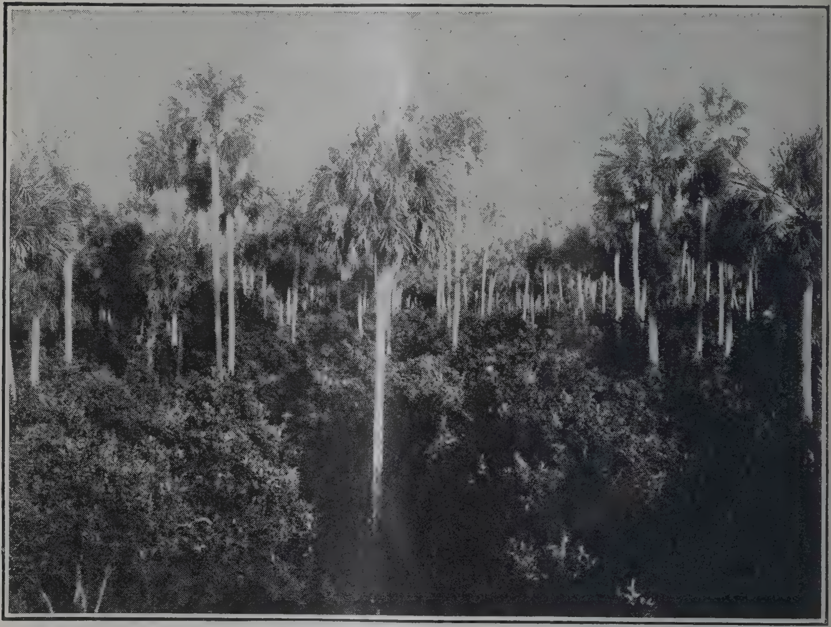


FIG. 5.—Florida orange trees planted among the native growth of palmettos.

Many growers advise the sowing of a cover crop on new land the summer before the trees are planted. This is an excellent plan, as the cover crop shades the bare land from the sun, and when turned under in the fall it adds humus and greatly improves the condition of the soil. When the ground is in good condition, however, the trees may be planted at once and cover crops sown later between the tree rows.

Planting season.—Citrus trees may be planted at any season of the year when the wood of the trunks is firm and they can receive proper attention as to water, protection, and other care. In Florida planting is usually done either in the winter, from December 15 to

February 15, or in summer after the rainy season starts. The winter is preferred, as at that season the ground is cool and moist and the trees become well established before the spring drought begins.

Most nurserymen offer their customers expert assistance in the planting and care of young trees, and where the grower is inexperienced it is often an excellent plan to secure such advice.

Planting plan and distances.—Groves are usually laid out in square or oblong rectangles, with the tree rows intersecting each other at right angles.

Opinions differ greatly as to the best distance apart for planting citrus trees. No specific distance can be given, as the proper spacing depends upon the soil, the stocks on which the trees were propagated, and the variety planted. Many citrus groves have been planted too closely. It is important to plant the trees far enough apart for convenience of spraying, cultivation, and other operations and so that the trees when fully grown will not shade and crowd each other.

A common distance for setting orange and grapefruit trees in Florida is 25 by 25 feet. In rich soils 30 by 30 feet is often preferred. A few growers set oranges and grapefruit 20 by 20 feet apart, or even closer, but such close planting is rarely advisable. Grapefruit trees often have a greater spread than oranges, and it is usually desirable, even on the same land, to space them at a greater distance. Tangerines are planted at the same distance as oranges. Satsuma oranges are set a little closer, frequently 20 by 20 feet or 15 by 20 feet. Lemons are usually planted 20 by 25 feet apart, limes 15 by 20 feet, and kumquats 10 by 15 feet.

In the other Gulf States, citrus trees are planted considerably closer than in Florida, especially when budded on trifoliate-orange stocks, which somewhat dwarf the tree. This close planting is also advantageous as a protection against cold and winds. In these sections orange and grapefruit trees are commonly set 20 by 20 or 20 by 15 feet apart and Satsumas 15 by 20 feet apart.

Some growers have planted their trees close together with the intention of removing every alternate tree at maturity or when the trees begin to crowd. This close planting increases the production during the first five years or so after the trees come into bearing and sometimes gives excellent results. Unless the grower has the courage, however, to cut out the alternate trees before they begin to interfere with each other, he will do best to confine his planting to the standard distance.

Wherever more than one variety of citrus fruit is planted, each sort should be in a block by itself. It is much easier to harvest the fruit when the trees are set in this way than where several varieties are mixed together.

After the ground has been prepared a stake should be set where each tree is to be planted. The tree rows should be laid out with great care in order to have them exactly straight. For large plantings the services of a surveyor may be secured. The inexperienced grower will find little difficulty in obtaining competent advice on this matter of laying out the grove. (Fig. 6.)

Setting the trees.—It is best to plant the trees as soon as possible after they are received from the nursery. If planting must be delayed the trees should be removed from the boxes or bales in which they are shipped and heeled in to prevent the roots from drying out. The roots should never be permitted to become dry, even for a short time. When they are taken to the field for planting they should be kept covered with wet sacking or carried in a barrel half filled with water.

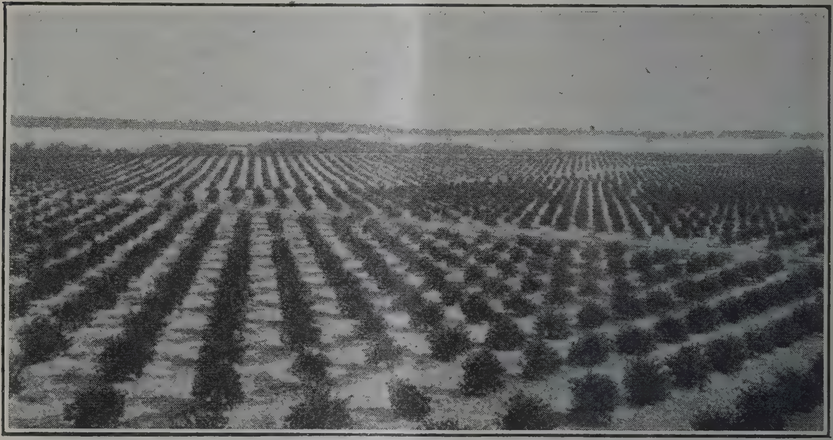


Fig. 6.—A well laid out 2-year-old citrus grove at Lucerne Park, Fla.

The holes dug for the trees should be of ample size to receive the the roots fail to make the best growth. The roots should be evenly planted, or at most not more than a day or so before the trees are set, as otherwise the soil will dry out too much. Just before they are planted all bruised and broken roots should be trimmed from the trees with a sharp knife. The trees should be set at the same level or an inch or so higher than they stood in the nursery. If set deeper the roots fail to make the best growth. The roots should be evenly spread out in the bottom of the hole and surface soil packed among them until they are well covered. It is very essential that this soil be well firmed and packed so that it is in close contact with the roots. Many growers mix in a pound or so of good commercial fertilizer with the soil used for filling the tree holes. Stable manure should not be used as a fertilizer at planting time, as it is sometimes injurious to young citrus trees (fig. 7). After the hole is filled with wellacked soil a shallow basin should be made about the tree (fig. 8) nd 5 or 10 gallons of water applied (fig. 9). To prevent the evapo-ation of moisture this basin should then be covered with a mulch f grass leaves or dry soil. When there is danger of frost, the basin hould be omitted and the trees mounded with soil so that the lower ortion of the tree up to a point well above where it was budded on he stock is protected from the cold. If the top is frozen back to the nound a new top can be developed from the protected part of the

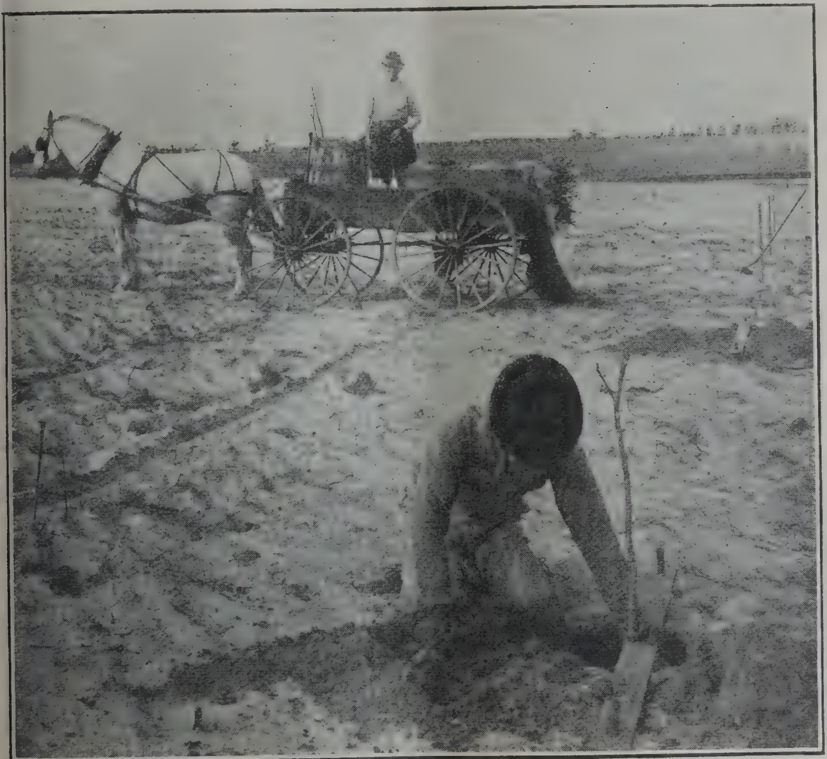


FIG. 7.—Planting a citrus tree, using a planting board. The trees are carried in a half barrel of water on the wagon until ready to go into the ground.

trunk. Dry, clean sod, free from waste or litter, should be used, as trash frequently attracts wood lice. As soon as the danger from cold is over, the mounds should be removed, as soil left mounded about the trunk in hot weather may favor bark diseases.

After the trees are planted they should be watered from time to time whenever their appearance indicates the need. Except during the rainy season the ground should be cultivated so that a dust mulch is formed and evaporation checked.

Pruning the trees at planting.—As soon as the young trees are planted, the tops should be cut back to make up for the heavy pruning which the roots have received in transplanting, as the balance between the root system and the top must always be maintained. Trees with a single unbranched stem are headed back to a bud at a height of 2 or 3 feet from the ground. Most growers prefer the lesser distance and make low-headed trees. Three or four lateral branches, well distributed about the upper 12 inches of the tree, should be permitted to grow and all other branches removed as soon as they start. When the trees are planted with a top already formed, the undesirable branches should be pruned off and only three or four desirable limbs left. These should be cut back to spurs with two or three buds on each spur. Weak trees and trees which fail to start readily after planting should be pruned still more severely. Trees that are well headed at planting time and carefully pruned for the next few years will need very little pruning after they reach maturity.

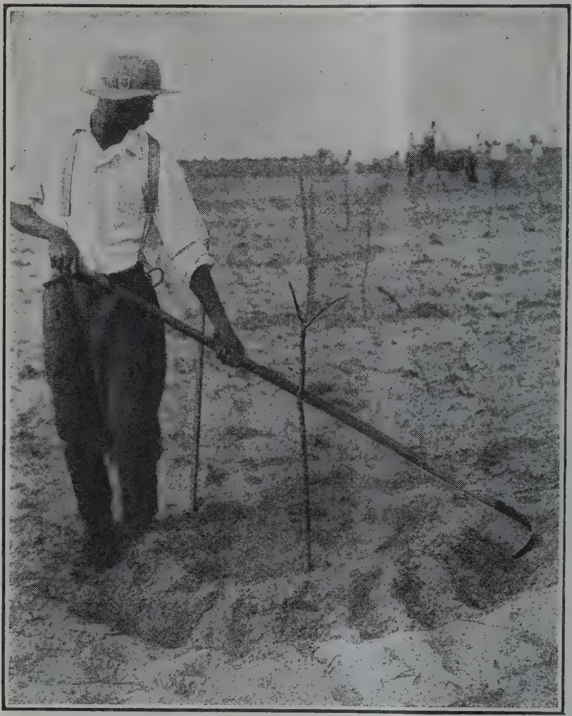


FIG. 8.—Making a shallow basin around a citrus tree after planting. This basin will be filled with water and finally covered over with a mulch of dry earth.

After the grove is planted it is an excellent plan to make an accurate diagram, showing the location of each tree and variety.

SYSTEMS OF MAINTAINING SOIL FERTILITY.

A system of soil management should be planned which will add humus to the soil, conserve moisture and fertility, and maintain the soil in the best condition for tree growth. The best system of cultivation will depend upon the particular conditions in each grove.

CLEAN CULTIVATION AND THE COVER-CROP SYSTEM.

Clean cultivation throughout the year, once widely practiced in Florida, has been abandoned, as it was eventually found that this method rapidly depleted the essential humus content of the soil. The most widely used system of handling soil in Florida is that of combining clean cultivation in the dry season with cover crops during the summer rainy season.

The main object of clean cultivation is to form a mulch of dry soil, so as to prevent the evaporation of moisture from below. This dust mulch is secured by plowing or disking the grove in the fall and harrowing at intervals of 10 days or 2 weeks throughout the dry season. It is only necessary to stir the upper 3 or 4 inches of the soil to get an effective dust mulch. Deeper tillage may injure too many of the feeding roots of the trees. Plowing should never be deep, especially in light soils. Many of the best growers never use a plow in their groves, depending entirely on the disk harrow, followed by the acme harrow.

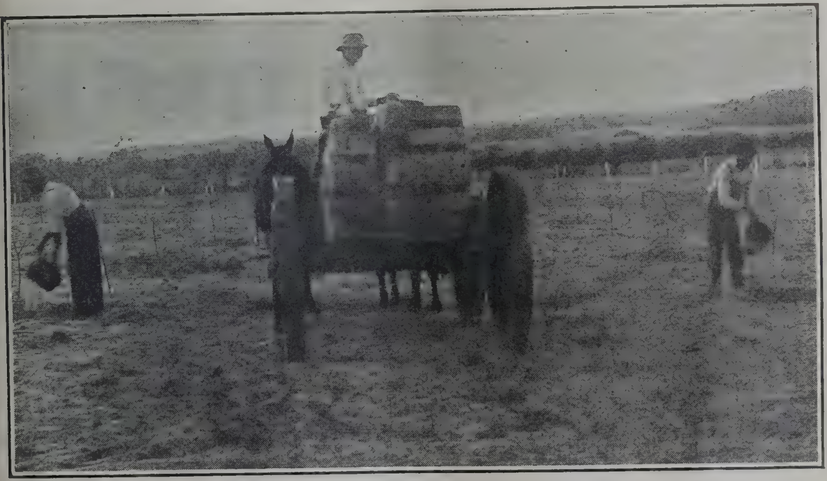


Fig. 9.—Watering citrus trees immediately after planting.

When the summer rainy season begins, cultivation is discontinued and a cover crop sown or a volunteer growth of weeds and native grasses allowed to spring up. This cover crop grows during the summer and the following October or November is plowed or disked under to add humus to the soil. Occasionally cover crops are left on the ground through the winter, but this is a questionable practice because of the danger of fire. In case the cover crop is rank or green it should be cut with a mowing machine and allowed to wilt before it is turned under. The cover crop should not be removed from the grove, but should be worked into the soil to improve its physical condition.

Some growers rely entirely on weeds for the cover crop, but most prefer to sow velvet beans, beggarweed, or cowpeas. All of these are leguminous crops, and in addition to adding humus to the soil they also add considerable nitrogen, which they derive from the air.

Velvet beans should be planted before the last of April for the best results. They may be sown broadcast, but it is preferable to plant them in drills or hills and cultivate the ground until they start. As velvet beans make a very rank growth of climbing vines some pains are required to keep them from running over the trees, but this is not a serious objection.

Beggarweed is an excellent cover crop, especially in Florida. If not cut too early in the fall, it is self-seeding and will come up every year. Sometimes two or more cuttings can be made the same season. Each cutting should be left to enrich the soil.

Cowpeas are a favorite cover crop in the Gulf States except in Florida, where they are only occasionally used. The Iron and Brabham varieties are the best to plant, as they are resistant to nematodes.

One objection to these leguminous cover crops is that they attract pumpkin bugs, sometimes a serious pest on citrus trees. When pumpkin bugs are numerous the cover crop should be cut by September 15. The cover-crop growth close to the trees and between the trees in the tree rows should be cut first, using a scythe where necessary. The pumpkin bugs, few of which are able to fly or travel far at this season, will then be forced to concentrate in the cover crop still standing in the row middles. When this part of the cover crop is cut the bugs are destroyed before they reach the dangerous stage.[1]

MULCHING SYSTEM.

A mulching system is used successfully by some citrus growers. Until about the tenth year clean cultivation in combination with cover crops is practiced, and after that time the weeds and grasses are allowed to grow the year round. The weeds are mown once or twice a year and left on the ground as a mulch. Leaves, hay, and other materials are sometimes brought into the grove and added to this natural mulch. Very fine fruit is produced by this mulching system, especially on moist hammock soils, but in nearly all groves the combination of clean cultivation with the cover-crop system will give better results.

FLAT-HOEING SYSTEM.

In a few groves all of the tillage is done with hoes. The weeds and grasses are cut off frequently at the surface of the ground and left as a mulch. This system, known as "flat hoeing," is most widely practiced on the rocky limestone soils of Dade County, Fla., where ordinary cultivation with harrows is impracticable.

---

[1] Watson, J. R. Insects of a citrus grove. Fla. Agr. Exp. Sta. Bul. 148, pp. 165–267, figs. 75–142. 1918.

INTERCROPS IN THE GROVE.

Profitable interplanted crops may sometimes be grown in the groves while the trees are young and before they require all the space. The land next to the young citrus trees should be kept cultivated and only the row middles used for the production of these intercrops.

On fertile soils truck crops, such as lettuce, beans, or cabbage, may be grown. In Florida, Natal hay and other forage crops are sometimes grown between citrus trees. Peaches are occasionally planted as intercrops and bear three or four crops before they are cut out. None of these intercrops should be planted close to the young citrus trees or allowed to impoverish the soil. Care must be taken, especially in growing vegetable intercrops, that the heavv fertilization does not overstimulate the citrus trees.

FERTILIZERS.

Most of the citrus soils in the Gulf States require the addition of fertilizers for the production of the most profitable fruit crops. The kind, quantity, and frequency of application of such fertilizers are all much-debated questions. They vary so greatly in each grove that only the general principles of citrus fertilization can be set forth in this bulletin.

The newcomer in a citrus section should consult growers of long experience in his locality and be guided by their advice in fertilizing his grove. He should also experiment for himself in the use of the various fertilizers, so as to determine the best combination and quantities for his conditions, which may differ from those even in adjacent groves. No cultural problem is more important or demands closer study on the part of the grower than that of fertilization.

The necessary elements of plant food which must be added to the soil in fertilizers are nitrogen, phosphorus, and potash. Nitrogen plays an important rôle in the production of new wood and leaf growth. Deficiency of nitrogen is indicated by yellow foliage and stunted growth of the tree. Excess of nitrogen, on the other hand, results in what is termed die-back, which causes the fruit to become thick skinned and puffy. The principal sources of inorganic or mineral nitrogen are nitrate of soda and sulphate of ammonia. The former is very quick in its action, while with sulphate of ammonia the effects are much slower. The chief sources of organic nitrogen are cottonseed meal, tankage, dried blood, and other plant and animal material. These are slower in their action than most inorganic nitrogenous fertilizers, and they must be used with care to avoid die-back. Nitrogen is also supplied to the soil in considerable amounts by velvet beans, cowpeas, and other leguminous cover crops.

Phosphorus is considered necessary for the proper development of the fruit. The chief sources of this element are bone and acid phosphate.

Basic slag, also known as Thomas phosphate, and ground raw phosphate rock are sometimes used as sources of phosphorus with good results on very heavy acid soils rich in humus. On nearly all Florida citrus soils, however, their action is too slow to make them either cheap or desirable fertilizers.

The common sources of the element potassium are sulphate and muriate of potash. The sulphate form is preferable, since the muriate sometimes has an injurious effect on citrus trees.

During our war with Germany potash became very scarce, and growers who formerly used 10 per cent or even more of this element in their fertilizer mixtures were unable to secure more than 2 or 3 per cent. The reduced quantity of potash has now been used for several seasons, but without apparent detriment to the trees or the fruit. As a result of their experience most citrus growers plan to continue the application of this reduced amount of potash and will use from 2 to 5 per cent of this element instead of the much greater proportion formerly applied.

FERTILIZERS FOR YOUNG TREES.

In Florida the usual practice is to fertilize young citrus trees three or even four times annually. The first application is made in the spring at the time the first flush of growth starts. One or two applications are made in summer and the last early in September. The spring and summer applications contain about 5 per cent of nitrogen, 6 to 8 per cent of phosphorus, and 2 or 3 per cent of potash. For the last application in the early fall the nitrogen is reduced to 2 or 3 per cent, in order to permit the trees to harden up in good shape for winter.

The total fertilizer used on trees the first year they are set is from 1 to 2 pounds. This is increased about a pound a year until the trees are 5 or 6 years old and begin to bear commercial crops of fruit.

FERTILIZATION OF BEARING TREES.

With bearing trees relatively less nitrogen is used than with younger trees, as it is not desirable to force wood growth. Three applications a year are usually made with mature trees. The spring and summer applications contain 3 or 4 per cent of nitrogen, 7 or 8 per cent of phosphorus, and 3 or 4 per cent of potash. The last application for bearing trees in Florida is made between November 15 and December 15 and contains but 2 or 3 per cent of nitrogen, with the same amounts of the other elements used in the spring and fall applications.

Bearing orange trees when 10 years old receive from 15 to 30 pounds of fertilizer a year. This quantity is increased as the crops become larger. Large bearing trees receive from 30 to 75 or more pounds of fertilizer annually. Many growers fertilize grapefruit somewhat more heavily than oranges.

The quantities of fertilizer used will vary with the type and fertility of the soil. Those specified above are applicable to soils of medium fertility, such as the best grade of Florida high pineland. On lighter, sandier soils the amount of fertilizer is increased 25 per cent or more, while on rich hammock soils it is reduced 25 per cent or even more. On rich soils it is also often advisable to reduce the relative proportion of nitrogen used in the formula. Where nitrogen-collecting leguminous cover crops are grown the amount of commercial nitrogen applied may also be somewhat reduced.

Trees that have been overfertilized may become affected with die-back. Die-back is nearly always combined with excessive growth and overfeeding, in contrast to mottle-leaf, or frenching, which affects weak, insufficiently nourished trees. The fruit on trees affected with die-back is coarse and puffy, or is "ammoniated," as the grower would say, and the young growth is often sickly and abnormal. Where such a condition exists, the amount of fertilizer should be reduced and cultivation stopped until the trees recover their normal condition.

Sometimes die-back is due to hardpan, poor drainage, or other unfavorable soil conditions, which must be remedied before the trees can permanently recover.

METHOD OF APPLYING FERTILIZERS.

Fertilizers should be spread evenly over the ground and then cultivated into the soil. Some growers broadcast their fertilizer by hand, but a fertilizer distributer is preferable, especially when the grove is large. The fertilizer should be distributed well out over all the ground shaded by the branches, so that the entire wide-spreading root system may be reached. In mature groves practically all the ground should receive fertilizer, while with very young trees it is only necessary to spread the fertilizer over a strip 3 or 4 feet wide on either side of the trunk. Care must be used to see that the fertilizer is kept a foot or two away from the trunks, as it is sometimes injurious to the crown roots.

BARNYARD MANURE.

In Florida the opinion prevails that barnyard manure is injurious to citrus trees and that its use frequently results in die-back. It is true that stable manure may have a bad effect, especially on trees growing in light soil, when it is applied in large quantities. When applied in small quantities, however, it is often one of the best fertilizers for citrus trees. Besides adding humus, stable manure promotes beneficial bacterial action in the soil.

Stable manure may be used profitably in somewhat heavier applications on heavy soils than on light, thin soils. On the comparatively heavy soils of California, as well as in Alabama and Louisiana, it is used in large quantities in the citrus groves with excellent results. On the lighter Florida soils the organic nitrogen of stable manure becomes available much more quickly than on heavier soils. For this reason stable manure must be used in smaller quantities on light soils in order to prevent overstimulation of the trees.

Lime is sometimes beneficial, especially on heavy soils rich in humus, but it must be used with caution, as heavy applications release plant food too rapidly, with the result that the soil becomes burned out and the tree growth impaired. On light citrus soils the use of lime is rarely advisable.

There are indications that citrus trees affected with the so-called mottle-leaf may be benefited greatly by a judicious use of stable manure. Mottle-leaf, or frenching, is of very common occurrence in Florida citrus groves. The affected trees have a general sickly, backward appearance, and the leaves show pronounced splotches of yellow between the veins and the midribs. In many cases the trouble seems to have originated through a too rapid depletion of soil humus, following applications of lime or intensive cultivation. Consequently, lime must be used with care on light soils. In the investigations mentioned above, it has been shown that mottle-leaf may be overcome and the trees restored to normal condition by the application of light amounts of stable manure combined with the growing of cover crops so as to restore the soil humus content.

Trees which by a general sickly appearance and yellowish leaves indicate a lack of nitrogen may also be benefited by several light applications of manure.

PRUNING CITRUS TREES.

When properly headed at planting time citrus trees require little pruning later. The general methods of pruning the trees when they are first set out were described in connection with the planting directions.

The pruning given during the first few years of the tree's life should be a continuation of that started when the trees were planted. All undesirable branches should be removed while they are still small and three or four limbs developed as a framework. Long, weak limbs that do not show a tendency to branch should be headed back, so that the tree will be kept strong, compact, and symmetrical. The top of the tree should not be allowed to become too dense, while on the other hand it should not be left so open that the trunk and inside branches are exposed to sun scald. Whenever it is necessary to prune off limbs whose removal will leave the inner branches exposed to the sun, the exposed branches should be protected from sun injury by a liberal coat of whitewash applied to reflect the heat. Well cared for bearing trees will need but little pruning. This pruning may be done at any time of the year when most convenient. Most growers prune in summer when other work is slack. The most important object is the removal of all dead, decayed, and injured wood. Such wood when left provides a breeding place for the fungus which causes melanose and stem-end rot, and the removal of this wood will tend to reduce the chances of these diseases developing.

It is best to maintain trees in good shape by pruning moderately every year, as heavy pruning is objectionable when trees have been long neglected. However, it is often advisable to prune them severely in order to put them into shape for good production. After a heavy pruning of this sort a vigorous growth of suckers, or water sprouts, will appear. These should be removed at once, except such as may be desired for developing into permanent branches. Sometimes a few water sprouts are left along the trunk and inner limbs and pinched back to form short inner fruiting branches. With most trees, however, the shade is too dense to favor much fruiting of these inner branches.

The principal tools used in pruning are the hand shears, knife, and saw. All tools should be kept as sharp as possible. It is very important to make the cuts clean and close to the trunk or branch left. Stubs should never be left, as they do not heal over well and eventually cause weak places in the tree. The large cut surfaces may be coated over with liquid grafting wax or white-lead paint.

Frozen trees should be pruned well back to good sound wood as soon as the extent of the injury is apparent, which will usually be within a few weeks after the freeze.

IRRIGATION.

In many of the Gulf coast sections a dry spell is frequently experienced during the spring months. These droughts are often the cause of damage to citrus trees, and some growers have resorted to irrigation as a means of insuring the setting of a good crop of fruit. (Fig. 10.)

In planning the installation of a system of irrigation the fact must be taken into account that in some years no long droughts occur and irrigation is unnecessary. The total expense of installing and maintaining an irrigation plant must be balanced against the advantages gained during the years when it is actually needed. It is therefore best to use as simple and inexpensive a system as will do the work. In many locations in Florida an efficient irrigation system for citrus groves can be cheaply installed, and most growers who have such systems consider them profitable investments.

Information concerning the irrigation of citrus groves in Florida can be obtained by writing to the United States Department of Agriculture for Department Bulletin 462, entitled "Irrigation in Florida."

PROTECTING GROVES FROM FROST.[1]

The freezes of 1895, 1899, 1917, and other years demonstrated to the citrus grower in the Gulf States the importance of being prepared to protect his trees from frost damage.

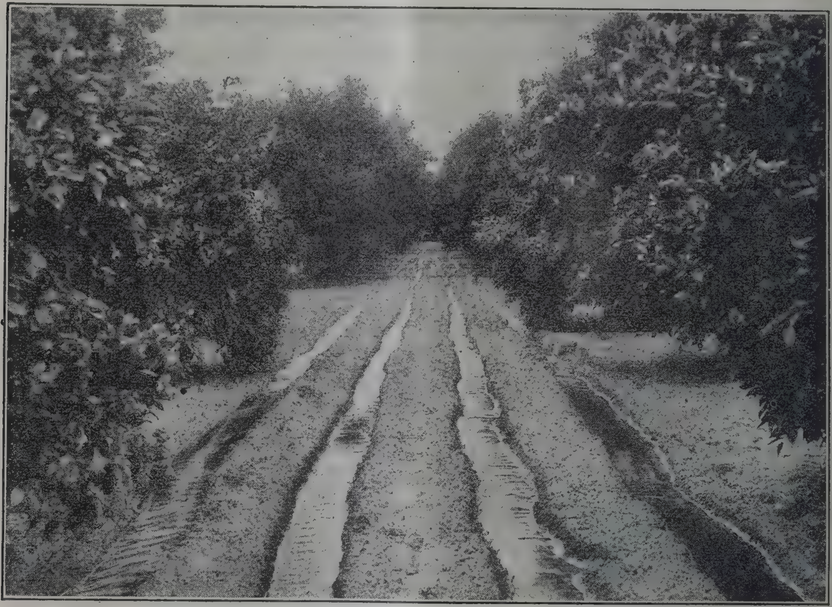


FIG. 10.—Furrow irrigation in citrus grove, Orlando, Fla.

Young trees should always be mounded in localities where killing frosts occur. In the freeze of February, 1917, thousands of young unmounded trees were frozen to the ground. In the case of properly mounded trees in the same localities, new shoots sprang from above the buds and the trees were restored with very little loss of time.

Many methods of frost protection have been advocated for citrus groves. Individual tents and sheds for entire groves have been tried, but were found too expensive and cumbersome. The principal methods of protection now used in the Gulf States are wood fires and coke or oil heaters. With each of these methods it has been found that it is the heat supplied and not the smoke or smudge that gives the protection.

---

[1] The reader should consult Farmers' Bulletin 1096, "Frost and the prevention of damage by it," which may be obtained free upon application to the Secretary of Agriculture, Washington, D. C.

In the course of a survey made of the Gulf State citrus sections immediately after the freeze of 1917 the results obtained by all of these methods were studied and compared. It was found that in practically every case where wood fires were used with care and intelligence very satisfactory results were obtained, even under the most trying circumstances.

WOOD FIRES.

A very striking example of the efficiency of wood fires when properly handled was shown in the 10-acre grove of Mr. L. D. Jones, near Orlando, Fla. This grove was exposed to the full sweep of the wind and a minimum temperature of 22° F. One half of the grove was heated by a large wood fire in every alternate square of trees. In this area practically no damage was done. Trees, fruit, and even some blossoms remained uninjured. In striking contrast to this part of the grove, the unprotected half was severely damaged.

The objection is sometimes made that wood firing is not suitable in a large grove on account of the labor involved. Several very large groves, however, were efficiently and cheaply fired with wood. One grove of more than 300 acres was successfully carried through a temperature of 21° F.

For wood fuel, pine logs and pine and oak stumps are frequently used. Some growers use discarded railroad ties, which they obtain for the expense of hauling.

Growers who fired two or three nights during the freeze of 1917 used from 10 to 15 cords of wood to the acre, at a cost of about $2 a cord. The quantity used was in proportion to the exposure of the grove and the temperature experienced. In old thickly planted groves less fuel was used than in young and open plantings. The total labor cost, including the cost of hauling in wood and preparing the fires averaged about $10 an acre, making the total cost of fuel and labor for two or three nights of firing about $40 an acre.

The most commonly used material for lighting wood fires was chips or waste from turpentine stills. A few growers used kerosene torch lighters with much success.

Most growers stow their wood in piles just outside the grove until the beginning of the danger season, when it is carried into the grove and piled in position for use. One pile in every square of four trees is usually made. In many cases it is not necessary to light more than each alternate pile until the cold becomes intense.

For lighting and caring for wood fires in small groves one man will be needed for every 2 acres, while in larger groves with better organization and equipment one man should care for 3 acres or even more.

OIL HEATERS.

Oil heaters were used in a number of groves, but failed to give satisfaction in many cases. This was due in part to the inexperience of the growers in handling oil. The most satisfactory type of heaters were those of large capacity, holding 9 gallons or more of oil. Too much refilling was necessary where small oil reservoirs were used.

In a number of instances growers attempted to use heavy oils which had been stored for a number of years and which had become so thick that they could not be lighted. Light distillates, on the other hand, were found to be in excellent condition, even after long storage.

The chief advantage of oil heaters as compared with wood fires is that the former, when skillfully handled, often give better regulation of temperature, and the fires can be started more quickly and with less labor. On the other hand, the initial cost is very high, often exceeding $200 an acre. It is believed that for the Gulf States wood will give much more satisfaction as to cheapness and efficiency than oil.

COKE HEATERS.

Coke heaters have been used by several growers with success. The coke is burned in metal stoves of special construction.

SPRAYING CITRUS TREES.

Citrus trees in the Gulf States are affected by a number of insect and disease pests. Most of these can be controlled or eliminated by proper grove sanitation, pruning, and spraying. Spraying is now recognized by most successful growers as essential to the profitable production of high-class bright fruit, as well as for the growing of healthy, vigorous trees.

As a result of a conference of several investigators engaged in the study of the control of citrus pests, the spraying schedule shown in Table IV was adopted for use in Florida groves.[1]

Further information concerning the nature and control of citrus diseases and insect pests in Florida and the other Gulf States may be obtained by writing to the United States Department of Agriculture, Washington, D. C., or to the appropriate State agricultural experiment station.

---

[1] At a conference at Orlando, Fla., February 27, 1919, participated in by H. R. Fulton, J. R. Winston, and J. J. Bowman, pathologists, and W. W. Yothers, entomologist, U. S. Department of Agriculture; H. E. Stevens, pathologist, and J. R. Watson, entomologist, Florida Agricultural Experiment Station; and E. W. Berger, entomologist, State Plant Board.

TABLE IV.—*A spray schedule for citrus trees.*

The five applications shown in boldface type, Nos. 3, 4, 7, 8, and 9, are recommended as sufficient for the control of the enemies usually destructive on grapefruit in an average season, provided the spraying is done thoroughly. Oranges will usually require only three applications (Nos. 7, 8, and 9). Under conditions unusually favorable for disease or insect increase, certain ones or all of the other applications will be required in addition.]

Application.	Kind of fruit.	Time of application.	Material.	Enemy.	Remarks.
No. 1	Grapefruit [1]	Just before first flush	Bordeaux mixture, 3-3-50	Scab	To be applied if scab is abundant on old leaves. When Bordeaux mixture is used it must be followed by two of the specified lime-sulphur applications within two months to reduce scale.
No. 2	do.	Just before petals open	Lime-sulphur solution, 32° Baumé; 2½ gallons in 100.	Scab, rust mites, red spiders, and scale crawlers.	To be applied if scab infections appear on new growth or if rainy weather favorable for scab follows application No. 1.
No. 3	**Grapefruit [1] and orange [2]**	**When one-third to one-half the petals are off.**	**Lime-sulphur solution, 2½ gallons plus nicotine sulphate, 13 ounces in 100 gallons.**	**Scab, thrips, rust mites, red spiders, and scale crawlers.**	**Add the nicotine if 25 or more thrips per bloom are present.**
No. 4	**Grapefruit [1]**	**7 to 10 days after application No. 3.**	**Lime-sulphur solution, 2½ gallons in 100.**	do.	
No. 5	do.	7 to 10 days after application No. 4.	do.	Scab, rust mites, and scale crawlers.	To be given if rainy weather favorable for scab infection follows application No. 4.
No. 6	do.	Apr. 5 to 15	Lime-sulphur solution, 1½ to 2 gallons in 100.	Rust mites, tearstain, and scale crawlers.	If any two out of applications Nos. 3, 4, and 5 have been given, this can be omitted; otherwise, this is the critical spraying for rust mites on grapefruit.
No. 7	**Grapefruit and orange**	**In May when fruit is at least 1 inch in diameter.**	**Oil emulsion, 1 per cent, plus dry soda sulphur, 2½ pounds in 100 gallons.**	**White fly, scale insects, and rust mites.**	**The oil emulsion should be used so that the diluted spray material will contain 1 per cent of oil, i. e., if the emulsion contains 66 per cent of oil, 1½ gallons will be required for 100 gallons of water.**
No. 8	**do.**	**In June**	**Lime-sulphur solution, 1½ to 2 gallons in 100.**	**Rust mites, tearstain, and scale crawlers.**	**On oranges, this is the critical rust-mite spray if the fruit has not received any previous lime-sulphur application.**
No. 9	**do.**	**Probably in September or October, but certainly before Feb. 1.**	**Oil emulsion, 1 per cent.**	**White fly and scale insects.**	**To be given if either scale or white fly is noticeable.**
No. 10	do.	November to January	Lime-sulphur solution, 1½ to 2 gallons in 100.	Rust mites and scale crawlers.	To be given only if rust mites are noticeable.

[1] The scab applications may be required on highly susceptible varieties of orange of the kid-glove type.

[2] Required on round oranges only when thrips are abundant.

Be cautious about using lime-sulphur solution when the temperature is above 90°. If used under this condition, use the weaker strength and be sure of the accuracy of the Baumé test and the diluting.

The Bordeaux mixture requires 3 pounds of bluestone and 3 pounds of first-grade quicklime in 50 gallons of water. Never use air-slaked lime. If hydrated lime or an inferior grade of quicklime must be used, make it 4 pounds.

REJUVENATION OF OLD GROVES.

Many of the older citrus groves in the Gulf States are no longer bearing as profitable crops as they did in former years. In many groves this deterioration, usually due to neglect, is very noticeable.

Where old trees are in very bad condition, especially when they are affected with foot-rot, it is usually best to grub them out and make a fresh start with young trees of standard budded varieties. If the trunks are in sound condition, however, a thorough pruning, followed by cultivation, fertilization, spraying, and general good orchard management, will often bring run-down trees into profitable bearing in two or three seasons, provided there is no inherent fault in the soil or the locality.

There are also many old groves, consisting of seedling or inferior budded trees, which might be very profitably budded or grafted over to standard varieties. Where the work is done carefully, such undesirable sorts can often be worked over within a few years into bearing trees of Pineapple, Homosassa, and other standard varieties, worth far more than the original trees.

In top-working undesirable trees of this sort two or three main limbs should be selected as a foundation for a new top. Additional limbs should be budded later, after the first buds have made a good start. The buds may be inserted directly into the bark of the limb itself at any season of the year when the tree is growing vigorously. Two or more buds are inserted at the base of each limb, and after these have made a good growth the old limb should be lopped off close to the new bud sprout. A second method of budding large limbs is to cut them back to stubs a foot or so in length. Sprouts will soon start from these stubs, and after the sprouts are half an inch or more in diameter two or three buds may be inserted in each of them. Two or three of these buds are permitted to develop at the base of each limb, and the others are eventually removed.

Mature trees may also be worked over by the methods explained in connection with the treatment of frost-injured trees.

Old orange trees on sweet-orange stocks are often badly affected with foot-rot. Such trees should be grubbed out and replaced with new trees on sour-orange or other resistant stocks. When foot-rot has not advanced too far, however, it is possible to save the affected tree by planting small resistant seedlings in the ground near the base and inarching the tops of these seedlings into the trunk of the large tree.

Figure 11 shows a fine, large, seedling sweet-orange tree which has been saved by changing its root system from the original sweet stock affected with foot-rot to resistant sour-orange stock by this method of inarching.

TREATMENT OF FROST-INJURED CITRUS TREES.

Trees that have been injured by cold often require severe pruning. Two or three weeks after the freeze the extent of the damage will be apparent, and the trees should then be cut back to sound, healthy wood. Cuts should be made clean and close to a growing limb or sprout whenever possible. The limbs or trunks when exposed should be whitewashed to protect them from the sun. After this pruning the injured trees should be carefully cultivated and fertilized, so that the most favorable conditions for the rapid recovery of the grove are afforded.

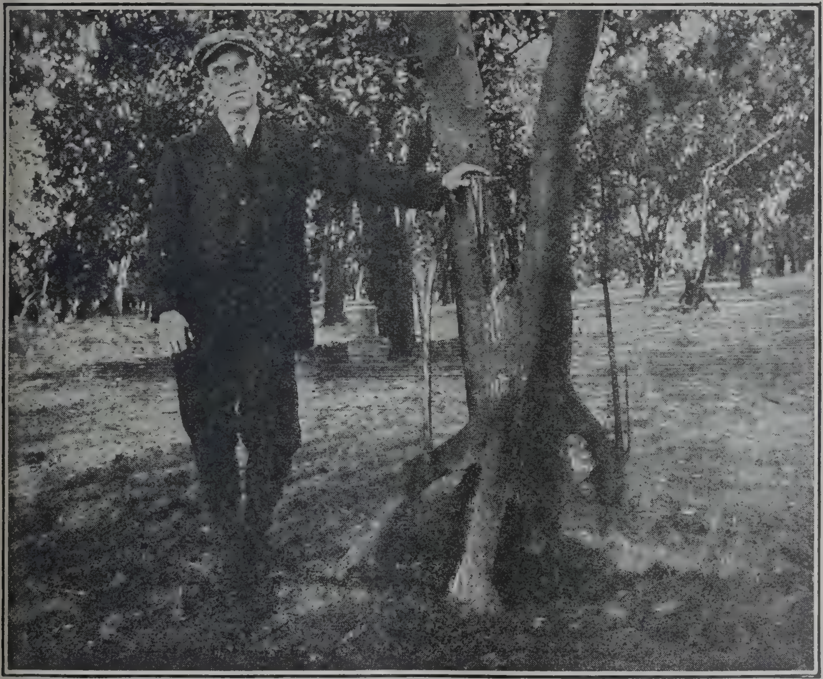


FIG. 11.—A large seedling sweet-orange tree affected by foot-rot saved by bridge grafting with resistant sour-orange stock. Dunedin, Fla.

When the bark is badly split on the trunks and limbs as a result of frost, the loosened bark may be tacked down and tied in place with raffia or cord. When there is still some live adherent bark this treatment has given good results when performed immediately after the injury occurred, before the bark had time to dry out. Painting the trunk with grafting wax or similar material is seldom beneficial, and may result in actual injury when the area so covered is large.

Citrus trees when not banked or mounded are sometimes so badly injured by frost that it becomes necessary to cut them off at the surface of the ground below the bud. In that event the sprouts which start from the old stump may be shield budded in the same manner as seedling stocks. Some growers prefer to crown graft. This is done by first cutting the old stumps back to clean live wood an inch or so below the ground; two or more scions of the desired standard variety are then inserted between the bark and the wood, and the stump is banked with moist soil until the tops of the scions are nearly covered. If the scions fail to take, the sprouts which will start from the stump may be budded. Crown grafting is best performed when the trees are dormant in the winter or fall, while sprout budding may be done at any season of the year when the bark slips readily.

Where badly injured trees are budded or grafted by one of these methods, buds of the best named varieties should be used. In many cases seedling trees after a freeze have been budded to standard varieties, with the result that within a few seasons the reworked trees were more valuable than before the freeze.

HARVESTING AND MARKETING CITRUS FRUITS.

The harvesting and marketing of citrus fruits is usually done by the fruit buyer or by one of the various cooperative associations rather than by the grower himself. The grower, however, should carefully superintend the operations in his grove and in the packing house in order to insure that his crop is handled in such a way that it can be marketed in the best possible condition.

Too much emphasis can not be placed on the necessity for care in the methods of handling citrus fruits at all stages. It has been shown in the course of investigations conducted in the Gulf States by the United States Department of Agriculture that much of the decay developing in citrus fruits prior to their arrival on the market is due to improper or careless methods of picking, packing, or shipping.[1]

In clipping the fruit from the trees some style of clipper should be used that will not puncture the fruit. Picking boxes should be kept clean and free from projecting nails or splinters and gravel. The packing-house machinery should be thoroughly inspected and adjusted so that the fruit is handled with the greatest possible care. Punctures and bruises resulting from neglect of these precautions are responsible for a large proportion of the cases of fruit decay.

Detailed information regarding the handling and shipping of citrus fruits, including information on packing-house operations and precooling before transit, may be secured by addressing the United States Department of Agriculture. (Fig. 12.)

---

[1] Ramsey, H. J. Handling and shipping citrus fruits in the Gulf States. U. S. Dept. Agr., Farmers' Bul. 696, 28 p., 10 fig. 1915. Available for free distribution.

Stubenrauch, A. V., Ramsey, H. J., Tenny, L. S., and others. Factors governing the successful shipment of oranges from Florida. U. S. Dept. Agr. Bul. 63, 50 p., 26 fig., 15 pl. 1914. Price, 20 cents. Obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

COSTS AND PROFITS IN CITRUS GROWING.

Many questions are asked as to the costs and profits in citrus growng. It is quite impossible to answer these queries satisfactorily for ny particular case, for citrus culture as an investment is compliated and uncertain.

In Florida the cost of planting and caring for a citrus grove luring the first four years, or until it reaches bearing age, ranges rom $250 to $500 an acre. This is exclusive of the cost of the land, ut it includes interest at 8 per cent on he money invested and payment for all labor done.

The price of unimproved citrus land in the Gulf States is governed by many factors, such as fertility, distance to city and shipping point, and the general standards and prosperity of the community. Desirable citrus land ranges in price all the way from $20 to $200, or even more, per acre. In some widely advertised localities the land has assumed a price too high for the conservative investor. By careful search the investor of limited means can locate desirable land at a comparatively low price, as there is plenty of low-priced land to be had in the less-developed communities.

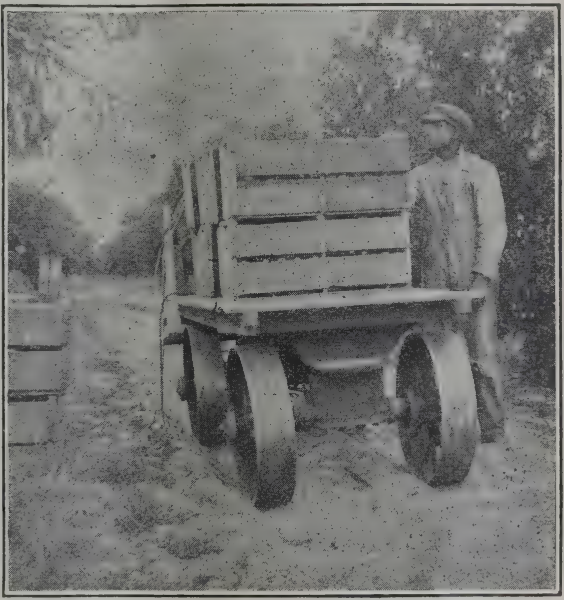


Fig. 12.—A low flat-wheeled orchard truck for hauling oranges from a Florida grove.

The annual cost of maintaining a grove in Florida after it reaches bearing age averages from $75 to $150 an acre. When all or most of the labor is performed by the grove owner the cash expenditure of starting and maintaining a grove may be reduced a third or even more.

The profits in citrus growing vary even more than the costs. The returns from some of the best groves are very high indeed, while, on the other hand, there are many poorly located or poorly cared for groves that are maintained at an actual loss.

Orange and grapefruit trees come to bearing age at about the fourth year, when they commonly yield about half a box to the tree. The crop increases annually at the rate of a half box or so until the trees come into full production about the tenth year. There are occasional groves which yield 500 boxes per acre or even more of grapefruit or oranges in a single season, but only the very best groves average more than 200 boxes annually. The average yield for Florida, including the best as well as the poorest groves, is about 150 boxes to the acre, or somewhat less than 2 boxes to the tree. There are commercial groves in Florida producing commercial crops at an age of 30 or 40 years.

Very heavy plantings of citrus trees have been made in the last 10 years, and many growers fear the danger of overproduction. While it is true that enormous crops of fruit may be harvested in the Gulf States in the near future, it is equally true that the market demand is increasing, and there is little danger but that clean, bright, high-grade fruit of the best standard varieties will average a good profit.

When all of these factors are taken into consideration it is evident that future profits in citrus culture will require the investor to exert the greatest skill and judgment at every step. Care is particularly essential when the available capital is limited. The man of wealth who invests in a citrus grove more as a winter home or a hobby than as a business has only to select a pleasing home site, of which there are very many in the Gulf States; in his case profits are of minor importance. On the other hand the man who must depend upon the returns from his grove for a living must exercise the greatest caution in selecting his grove and the greatest skill and energy in its development. The risk from frost, as well as the more common sources of loss, must be taken into consideration.

Before purchasing citrus lands or groves the investor should make a personal visit to the locality and carefully study the situation. It is rarely advisable to buy land or to develop a grove unless the owner can give the property his personal attention. It is much safer for the beginner to start in citrus growing on a small scale and expand after learning the business than to plunge heavily at the start.

The prospective purchaser can secure much valuable information by consulting with successful growers, and it is an excellent plan to hire out for a season or two with some experienced grower before purchasing land or planting a grove. The United States Department of Agriculture and the State agricultural experiment stations will gladly supply information when requested.

PUBLICATIONS ON CITRUS FRUITS.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT OF AGRICULTURE.

The Propagation of Plants. (Farmers' Bulletin 157.)
Pruning. (Farmers' Bulletin 181.)
Control of the Citrus Thrips in California and Arizona. (Farmers' Bulletin 674.)
Handling and Shipping Citrus Fruits in the Gulf States. (Farmers' Bulletin 696.)
Bridge Grafting of Fruit Trees. (Farmers' Bulletin 710.)
Citrus-Fruit Improvement: How to Secure and Use Tree-Performance Records. (Farmers' Bulletin 794.)
Information for Fruit Growers about Insecticides, Spraying Apparatus, and Important Insect Pests. (Farmers' Bulletin 908.)
Fumigation of Citrus Trees. (Farmers' Bulletin 923.)
Control of the Argentine Ant in Orange Groves. (Farmers' Bulletin 928.)
Spraying for the Control of Insects and Mites Attacking Citrus Trees in Florida. (Farmers' Bulletin 933.)
Growing Fruit for Home Use. (Farmers' Bulletin 1001.)
The Woolly White Fly in Florida Citrus Groves. (Farmers' Bulletin 1011.)
Frost and the Prevention of Damage by It. (Farmers' Bulletin 1096.)
The Mulched-Basin System of Irrigated Citrus Culture and Its Bearing on the Control of Mottle-Leaf. (Department Bulletin 499.)
The Argentine Ant in Relation to Citrus Groves. (Department Bulletin 647.)
Citrus-Fruit Improvement: A Study of Bud Variation in the Eureka Lemon. (Department Bulletin 813.)
Citrus-Fruit Improvement: A Study of Bud Variation in the Lisbon Lemon. (Department Bulletin 815.)
Frost Protection in Lemon Orchards. (Department Bulletin 821.)
Propagation and Marketing of Oranges in Porto Rico. (Porto Rico Experiment Station Bulletin 4.)
Citrus Fertilization Experiments in Porto Rico. (Porto Rico Experiment Station Bulletin 18.)
Cooperative Work for Eradicating Citrus Canker. (Separate 711, from Yearbook, 1916.)
Tangelos: What They Are. The Value in Florida of the Sampson and Thornton Tangelos. (C. P. and B. I. Circular 4.)
Varieties of the Satsuma Orange Group in Japan. (C. P. and B. I. Circular 5.)

PUBLICATIONS FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Scale Insects and Mites on Citrus Trees. (Farmers' Bulletin 172.) Price 5 cents.
Propagation of Citrus Trees in the Gulf States. (Farmers' Bulletin 539.) Price 5 cents.
Culture, Fertilization, and Frost Protection of Citrus Groves in the Gulf States. (Farmers' Bulletin 542.) Price 5 cents.
Factors Governing the Successful Shipment of Oranges from Florida. (Department Bulletin 63.) Price 20 cents.

Citrus Fruit Insects in Mediterranean Countries. (Department Bulletin 134.) Price 15 cents.

Katydids Injurious to Oranges in California. (Department Bulletin 256.) Price 10 cents.

The Production of Sweet-Orange Oil and a New Machine for Peeling Citrus Fruits. (Department Bulletin 399.) Price 5 cents.

The Navel Orange of Bahia; with Notes on Some Little-Known Brazilian Fruits. (Department Bulletin 445.) Price 20 cents.

Irrigation in Florida. (Department Bulletin 462.) Price 15 cents.

The Citrus Thrips. (Department Bulletin 616.) Price 10 cents.

Citrus-Fruit Improvement: A Study of Bud Variation in the Washington Navel Orange. (Department Bulletin 623.) Price 15 cents.

Citrus-Fruit Improvement: A Study of Bud Variation in the Valencia Orange. (Department Bulletin 624.) Price 25 cents.

Some Reasons for Spraying to Control Insect and Mite Enemies of Citrus Trees in Florida. (Department Bulletin 645.) Price 5 cents.

Citrus-Fruit Improvement: A Study of Bud Variation in the Marsh Grapefruit. (Department Bulletin 697.) Price 20 cents.

The Decay of Oranges while in Transit from California. (Bureau of Plant Industry Bulletin 123.) Price 20 cents.

A Knot of Citrus Trees Caused by Sphaeropsis tumefaciens. (Bureau of Plant Industry Bulletin 247.) Price 15 cents.

The Limitation of the Satsuma Orange to Trifoliate-Orange Stock. (Bureau of Plant Industry Circular 46.) Price 5 cents.

Insects Injurious to Citrus Fruits and Methods for Combating Them. (Porto Rico Experiment Station Bulletin 10.) Price 10 cents.

New Citrus Creations of the Department of Agriculture. (Separate 343, from Yearbook, 1904.) Price 5 cents.

The Woolly White Fly: A New Enemy of the Florida Orange. (Bureau of Entomology Bulletin 64, Part VIII.) Price 5 cents.

Fumigation for the Citrus White Fly, as Adapted to Florida Conditions. (Bureau of Entomology Bulletin 76.) Price 15 cents.

White Flies Injurious to Citrus in Florida. (Bureau of Entomology Bulletin 92.) Price 25 cents.

Natural Control of White Flies in Florida. (Bureau of Entomology Bulletin 102.) Price 20 cents.

Preparations for Winter Fumigation for the Citrus White Fly. (Bureau of Entomology Circular 111.) Price 5 cents.

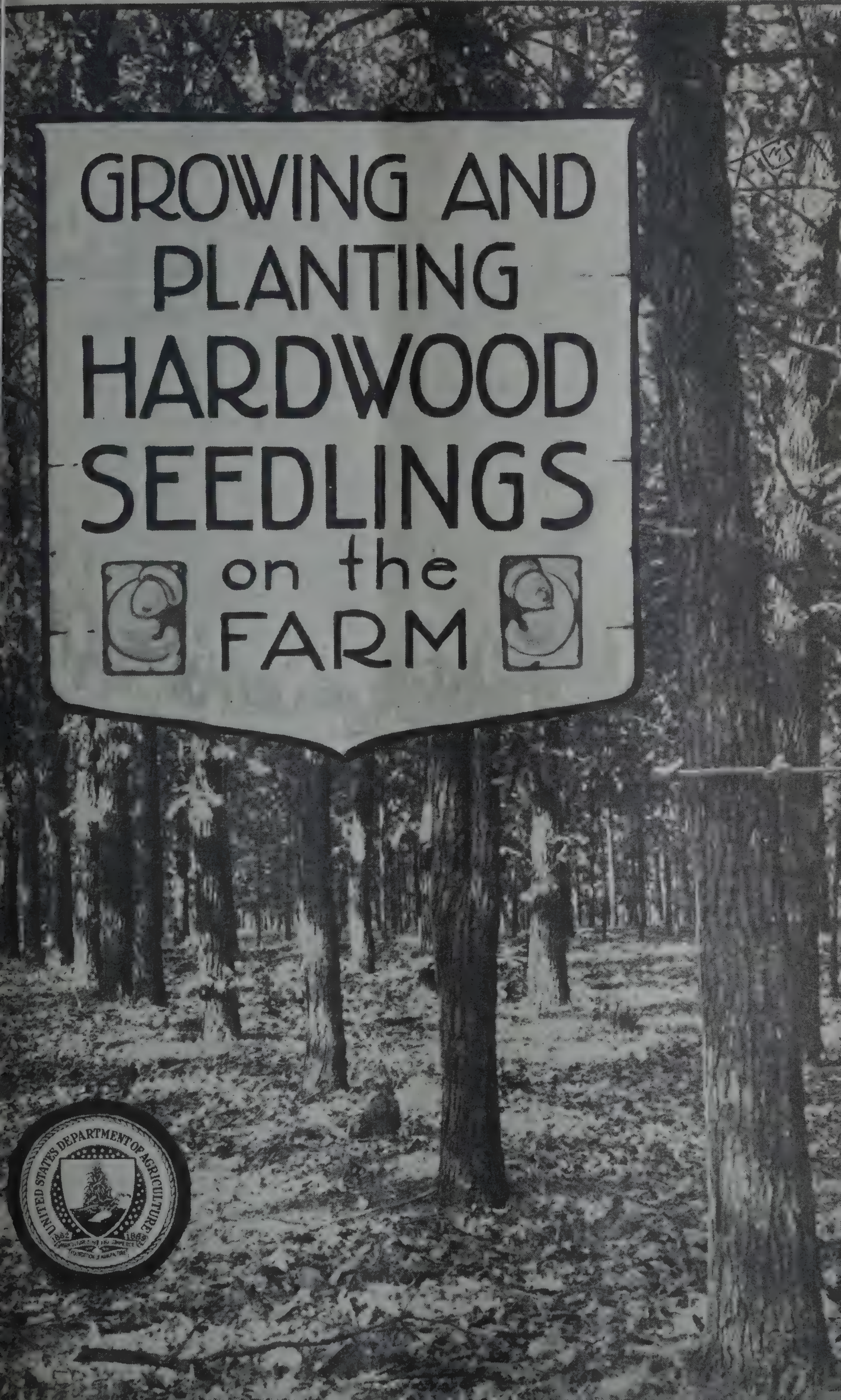
Spraying for White Flies in Florida. (Bureau of Entomology Circular 168.) Price 5 cents.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

FARMERS' BULLETIN 1123

NITED STATES DEPARTMENT OF AGRICULTURE

GROWING AND PLANTING HARDWOOD SEEDLINGS on the FARM



FOREST TREES grown on the farm add to its value and beauty. They supply material for farm use, such as poles, posts, and cordwood; and they afford shelter for live stock, and protect crops and buildings from the hot winds of summer and the cold winds of winter. Moreover, they can often be grown successfully on soils too poor or on slopes too steep for the successful production of the ordinary agricultural crops.

It is the purpose of this publication to point out simple methods which may be followed in planting and caring for hardwood trees on the farm and in collecting, extracting, and storing the seed of the common hardwood trees of the United States and in growing the young trees in a home garden or nursery.

Contribution from the Forest Service
WILLIAM B. GREELEY, Forester
Washington, D. C. **January, 1921**

GROWING AND PLANTING HARDWOOD SEEDLINGS ON THE FARM.

C. R. TILLOTSON, *Forest Examiner.*

CONTENTS.

	Page.
hat trees to grow	3
lanting two or more kinds of trees together	5
ocation of plantation or windbreak	6
stablishment of plantation	7
are of plantation	12
Sources of planting stock	17
Seed collection, extraction, and storage	17
Growing the seedlings	22
Sources of information and advice for the planter	28

WHAT TREES TO GROW.

IN DECIDING on the species of hardwood trees to be grown on the farm, one should keep in mind, first, the object of growing the rees, and, second, their adaptability to the climate of the region and o the situation in which they are to be planted. To illustrate: The oxelder is not a good tree to plant for lumber; yellow poplar, because f climatic conditions, can not be grown successfully in the plains egion of the central United States; and hardy catalpa will not thrive n poor sandy or heavy clay soils. To a certain extent trees may be grouped as those most valuable for lumber, for posts and poles, for windbreaks, etc. An attempt has been made in Table 1 to group the hardwood trees according to their suitability for such uses. The second consideration is very important. Too often prospective planters are dazzled by tales of trees that will thrive on any and all soils, that will grow with extreme rapidity, that are imperishable when set out as posts, or that are much more valuable than other species for lumber. It is usually safe to assume that such reports have little foundation in fact. *The best trees for planting on the home farm are usually those that grow naturally on similar soils in the region* or those that have been tried out by the neighbors and have been proved a success. Many plantations have turned out to be failures, with resulting disappointment to their owners, because of the selection of trees unsuited either to the climate or to the soil of the planting site.

NOTE.—This bulletin does not represent original work by the writer. The information it contains has been compiled from numerous sources. The writer is indebted especially to Prof. J. S. Illick, of the Pennsylvania department of forestry, for considerable information and many helpful suggestions.

TABLE 1.—*Hardwood trees most valuable for various purposes.*

Lumber.	Handle stocks.	Excelsior.	Railroad ties and round mine timbers.	Cooperage stock
Ash.	Ash.	Aspen.	Black locust.	Ash.
Basswood.	Beech.	Basswood.	Honey locust.	Basswood.
Beech.	Birch.	Cottonwood.	Red oaks.	Beech.
Birch.	Hickory.	Willow.	White oaks.	Birch.
Black cherry.	Sugar maple.	Yellow poplar.		White elm.
Cottonwood.	White oaks.			Sugar maple.
Cucumber.				White oaks.
White elm.				Red gum.
Hickory.				
Sugar maple.				
Red oaks.				
White oaks.				
Red gum.				
Sycamore.				
Black walnut.				
Yellow poplar.				

Veneer logs.	Poles and posts.	Hardwood distillation.	Windbreaks.
Basswood.	Hardy catalpa.	Beech.	Green ash.
Beech.	Coffee tree.	Black birch.	Boxelder.
Yellow birch.	Red elm.	Yellow birch.	Cottonwood.
Black cherry.	Eucalypts.	Sugar maple.	Eucalypts.
Sugar maple.	Black locust.		Hackberry.
Oaks.	Honey locust.		Silver maple.
Red gum.	Russian mulberry.		Russian mulberry.
Sycamore.	Oaks.		Osage orange.
Black walnut.	Osage orange.		Russian olive.
Yellow poplar.	White willow.		White willow.
			Yellow willow.

The planter will doubtless be influenced in his choice of species b their rates of growth. Tables 2 and 3 show this approximately fo the kinds of trees for which growth figures are available. The rate indicated may be too low for some trees in some regions, but it believed that the tables are reliable for purposes of comparison.

TABLE 2.—*Average diameter growth of hardwood trees.*

Average number of years required to grow each inch in diameter.	Species.
½ to 3 years	* Eucalypts.
2 to 4 years	* Cottonwood, black willow, * white willow,* honey locus * black locust.
3 to 6 years	Red gum, * silver maple, *white elm, * Russian mulberr yellow poplar, chestnut, * hardy catalpa.
4 to 7 years	* White ash, * green ash, * boxelder, * black walnu * butternut, red oak, black oak, * bur oak, aspe * osage orange, basswood.
5 to 10 years	Hickory, white oak, chestnut oak, paper birch, *har maple, yellow birch, beech.

The table is based upon the growth of trees both in plantations (those starred) and in natural forest (tho not starred). In plantations more rapid growth can often be secured, particularly of the trees named in th last line.

TABLE 3.—*Height growth of hardwood forest trees produced from seed.*

[Average height.[1]]

Species.	At 10 years.	At 20 years.	At 30 years.	At 50 years.
	Feet.	*Feet.*	*Feet.*	*Feet.*
reen ash	26	41	52	70
hite ash	19–25	34–50	45–67	62–83
spen	8–21	17–40	28–55	50–75
asswood	....	16–32	23–44	37–63
eech	....	8–19	13–28	22–42
aper birch	13	30	44	62
ellow birch	....	*–30	8–39	15–54
oxelder [2]	20	....	....	....
ardy catalpa [2]	19	27	33	....
hestnut	7	17	33	64
ottonwood [3]	56	97	115	136
White elm	....	21	28	40
ucalyptus [2] (blue gum)	24–80	70–90	85–160	....
hagbark hickory	3– 7	8–18	15–32	32–51
lack locust	15–20	28–45	....	44–65
oney locust [2]	18	27	35	....
ilver maple [2]	22	44	60	80
ugar maple	....	*–18	*–29	10–48
ur oak [2]	....	....	40	60
Red oak	13	32	46	72
White oak	11–12	22–25	32–38	53–63
sage orange [2]	....	15–25	37	....
Red gum	35	66	88	108
Black walnut [2]	18	30	40	60
Black willow [3]	50	73	89	109
White willow [2]	15–24	35–50	....	....
ellow poplar	20–27	36–50	50–64	78–83

*Data not available.

[1] The slower growth in each case is on poor situations; the more rapid growth, on better situations. Where nly one figure is shown, it represents approximately the average growth on all situations where measurenents have been recorded. In plantations, the height growth should equal and often exceed the faster ate of growth indicated by the table.

[2] Growth in plantations on farm lands.

[3] Measurements made on trees in the lower Mississippi Valley where growth is very rapid.

PLANTING TWO OR MORE KINDS OF TREES TOGETHER.

A mixture of two or more kinds of trees in a plantation may sometimes be desirable, although it is not ordinarily recommended. For their best development, some trees, such as cottonwood, should be spaced widely in a plantation; others, such as black walnut and black locust, have such scant foliage that their shade does not prevent the growth of a heavy sod of grass. In both of these cases, a mixture will more completely utilize the area planted, increasing the yield and bringing about better forest conditions in the plantation.

Mixtures may be desirable for other reasons. Planting stock of one species alone may be expensive; and if a less valuable tree, or filler, to be cut out when the trees begin to crowd, is mixed with the main crop, it will keep down the first cost. If a species to be planted is liable to serious diseases or insect attack, as are chestnut and black locust, the planting in mixture with another kind of tree not liable to such attack will provide for a stand of trees in case the chestnut or locust is killed.

The following list gives a number of hardwood mixtures which should prove successful on soils and in regions adapted to both species. It can not be stated with assurance that these mixtures will produce a satisfactory stand, because experience with them has not been sufficient to serve as a strict guide. Ordinarily, planting of one species only are more satisfactory:

Hardwood mixtures for planting.

Cottonwood and silver maple.
Cottonwood and green ash.
Honey locust and hackberry.
Honey locust and green ash.
White elm and hackberry.
White elm and green ash.
White elm and white ash.
Black walnut and green ash.
Black walnut and hackberry.
Black walnut and hickory.
Black walnut and white oak.
Black walnut and white ash.
Black locust and yellow poplar.
Black locust and white oak.
Black locust and boxelder.
Black locust and hickory.
Yellow poplar and white oak.
Yellow poplar and hard maple.
Yellow poplar and hickory.
Red gum and white oak.
Red gum and hickory.
Red gum and beech.
Green or white ash and hackberry.
Green or white ash and hickory.
Red oak and basswood.
Red oak and white oak.
Red oak and hard maple.
Red oak and hickory.

LOCATION OF PLANTATION OR WINDBREAK.

Generally speaking, unless intended for windbreaks, plantations should be located on the poorest soil of the farm, that least suited to the production of agricultural crops. Hillsides and poorly drained or rocky or sandy situations should be selected, if there are such. Corners of the farm cut off by a stream or railroad may be chosen. If there are no such situations on the farm, the plantation should be located near the buildings, where it will not only be convenient but will serve as a windbreak.

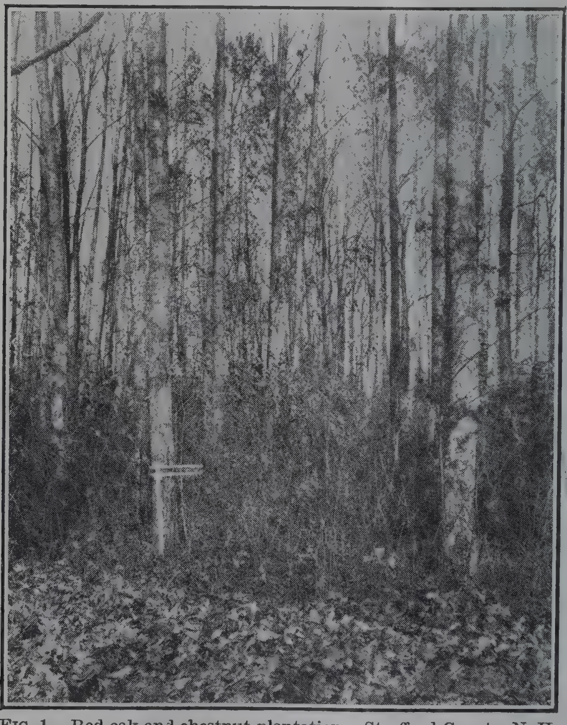


FIG. 1.—Red oak and chestnut plantation. Strafford County, N. H.

Windbreaks for protection of the home and buildings should be located on that side of the buildings and the stock-feeding yards against which the prevailing winter winds blow. If a narrow windbreak of only a few rows is planted, it should be several rods away from the building or yard. Snow drifts under the lee of such a windbreak and lies deep around buildings or a feed lot close to it. This drifting may be partially prevented by planting two such narrow windbreaks parallel to each other and about two rods apart. Snow will then drift into and for the most part be held in this intervening space.

Windbreaks for crop protection should be located so as to protect the crop from the most damaging winds, usually summer winds. As efficient windbreaks exert their protective influence along the surface to a distance of from fifteen to twenty times their height, the intervals between them should be about fifteen or twenty times the height of the trees at their maturity.

ESTABLISHMENT OF PLANTATION.

PLANTING OF STOCK.

In starting a grove, the planter ordinarily has the choice of using seedlings, seed, or cuttings. Seedlings 1 or 2 years old are preferable in the great majority of cases. They are fairly cheap and have the best chance of succeeding.

Nut trees, such as walnut, hickory, and oak, develop a very deep taproot and few lateral feeding roots during their first year. They can not ordinarily be transplanted to the field so successfully as other trees, so that planting the nuts or acorns on the permanent site is usually considered preferable. Black walnut plantations have been successfully started by the use of sprouted nuts. It would seem that the same method might be followed with other nut trees.

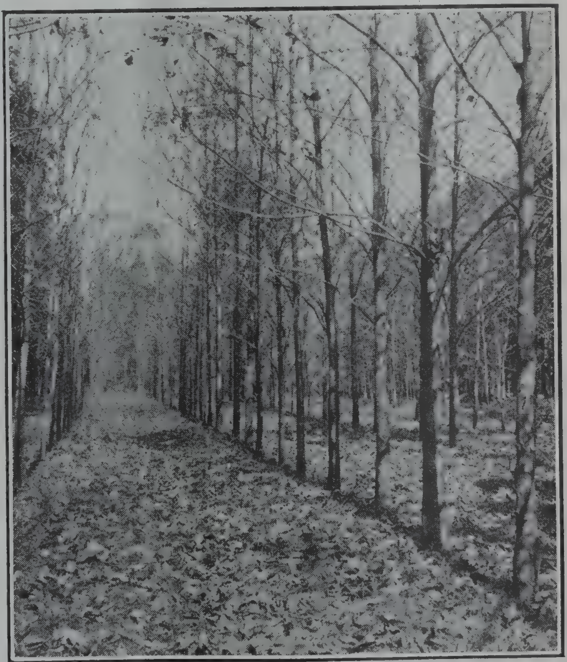


FIG. 2.—Shellbark hickory plantation, 27 years old. Champaign County, Ill.

Cottonwood and willow plantations are most easily started with cuttings. These are simply from 12 to 14-inch sections taken from the 1 or 2 year old twigs of living trees. The cuts should be made with a sharp tool, to avoid bruising the bark. Cuttings should be collected during early winter and buried in moist sand in a cool place until the time for planting.

PREPARATION OF SOIL.

The necessity of soil preparation will depend somewhat on the region. On the prairies or in other regions where tree growth does not naturally thrive, the area should be plowed, preferably in the fall. In regions where trees naturally thrive, such preparation, is also decidedly beneficial although not always necessary. *Heavy sod land in any region should not be planted until it has been plowed and cropped for two or three years.*

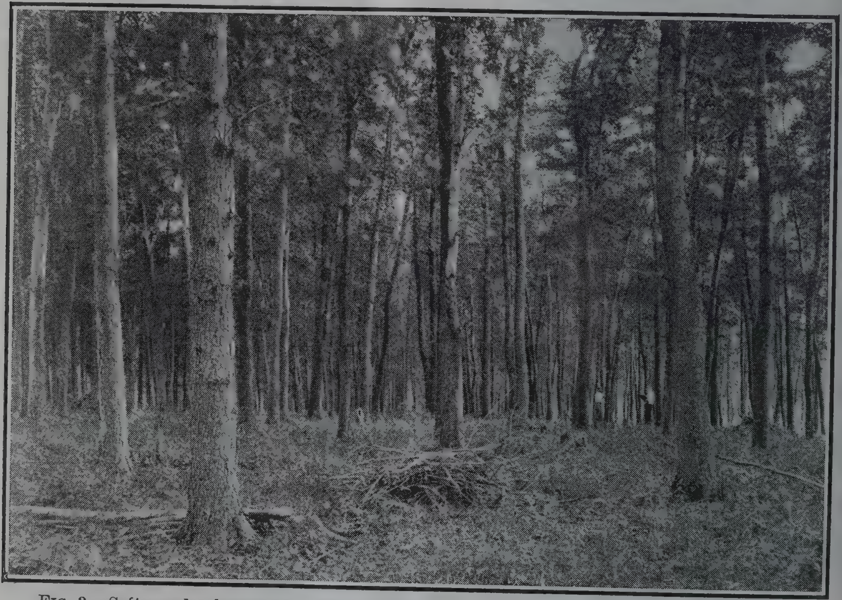


FIG. 3.—Soft maple plantation. Trees 5 to 13 inches in diameter. Jefferson County, Iowa.

METHODS OF PLANTING AND SOWING.

SLIT.

In the slit method a wedge-shaped hole is opened in the ground by inserting a spade or mattock and moving it backward and foreward. The root of the tree, or the cutting, is then inserted back of the tool in the cleft thus formed, the tool is removed, and the earth is pressed with the foot firmly around the plant. If the root systems are not overlarge, this method may generally be used with success in light soil that is free from rocks.

INDIVIDUAL HOLES.

If the soil is heavy or rocky, or if the trees have large root systems, the best method is simply to dig a hole for each individual tree, pull the soil in over the roots, and tamp it thoroughly. This is undoubtedly the surest method for trees of large size.

PLANTING SPROUTED NUTS.

A simple and successful method of planting black walnut was discovered by a farmer in Indiana. It should be equally successful, it seems, with the oaks, hickories, butternut, or any other hardwood species which develop pronounced taproots and in consequence can not be very successfully transplanted from the nursery to the field. This farmer buried the walnuts in a shallow pit where they were subjected throughout the winter to the action of moisture and frost. With the advent of warm spring weather, the nuts began to sprout. He planted the sprouted nuts on well-tilled land by scooping out a little soil with his hands, placing the nuts in the holes thus formed, and covering them lightly. In following this plan there are several precautions which should be taken: (1) The pit in which the nuts are stored should be located in a well-drained, shaded spot; (2) the nuts should be protected against destruction by rodents; and (3) they should be examined frequently in the spring so that there will be no delay in setting them out shortly after sprouting commences.

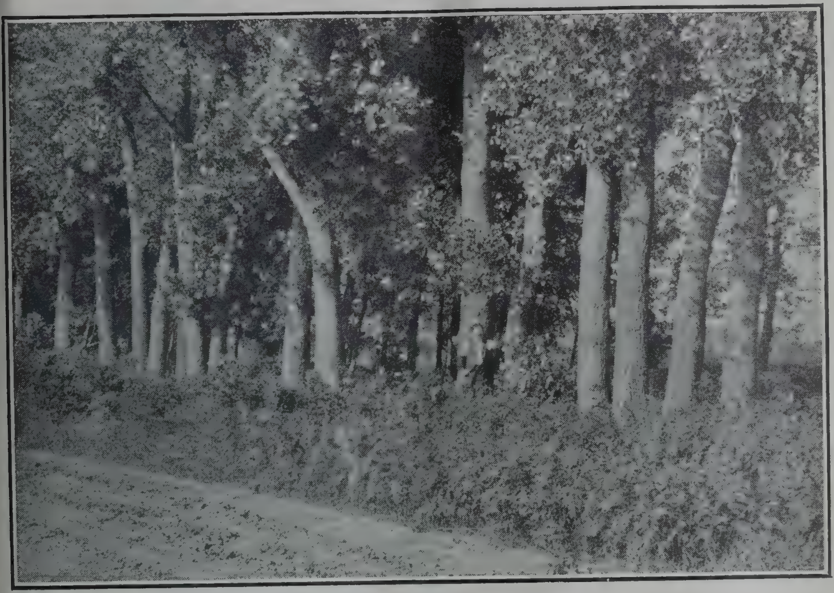


FIG. 4.—Cottonwood and green ash windbreak. Butler County, Nebr.

FURROW.

The young trees or seeds may be planted in a plowed furrow. This is a rapid method and usually quite successful. It is especially suitable for planting cottonwood and willow cuttings. Seedlings are set in the bottom of the furrow, and loose earth is pulled around the roots and tamped firmly. Cuttings are set in the furrow with the lower ends down in a slanting position. About 1 or 2 inches of the cuttings should be left extending above the surface of the ground. Soil is then pulled in and trampled firmly about them. Seeds are dropped in the furrow, several in a spot at regular intervals, and covered with 1 or 2 inches of soil.

SEED SPOT.

In the seed-spot method seed are sown directly on the planting s in spots at regular intervals. The ground in these spots is usual stirred somewhat with a spade or mattock, then several seed are dropped on the spot and covered to a depth of 1 or 2 inches with soil. This method is particularly suitable for fall sowing of the seed of the oaks, hickories, black walnut, and butternut.

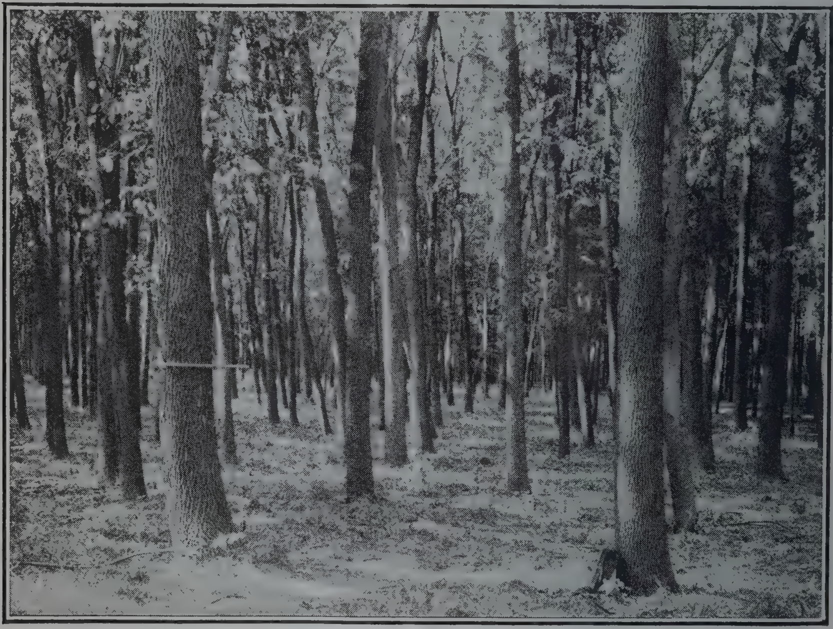


FIG. 5.—Green ash plantation, 40 years old. Champaign County, Ill.

BROADCAST SOWING.

The seed may be scattered broadcast over an area, either plowed or unplowed, in the same manner as wheat and oats are sown. This method is not recommended for any species, as it requires a large quantity of seed to the acre and is likely to be unsuccessful.

SEASON OF PLANTING OR SOWING.

In general, early spring planting is preferable to planting at any other season. As compared with fall planting, it has at least two listinct advantages: The stock has a whole growing season in which o become established before it is subjected to the rigors of winter; nd it is not in immediate danger of being heaved out of the ground y alternate freezing and thawing. If there is no great danger of the eeds being disturbed by rodents during the winter, fall is the preferale season for direct sowing of the seed of nut-bearing trees and of he oaks. When this danger exists, spring sowing is advisable.

SPACING OF TREES IN PLANTATION.

timber is the primary object of a plantation, rather close spacing advisable. This method produces trees with straight bodies and ew branches, and hence of high lumber value. If the primary object is protection, close spacing in the rows and wide spacing between them is best; for it will produce trees with some branches extending nearly to the ground, and hence will give the greatest protective efficiency. The actual spacing desirable for these two purposes depends upon the characteristics of the tree, upon the region, and upon the area or site to be planted. Trees which grow well in shade, such as hard maple and beech, may be planted more closely than those which require abundant light, such as cottonwood and yellow poplar. On situations which because of poor soil are unfavorable to tree growth, closer spacing is advisable than on more favorable situations. The greater number of trees to the acre will compensate for the higher mortality soon after they are set out, and, through the greater amount of shade furnished, will afford better protection to the soil. In regions of little rainfall there will not be sufficient moisture to support a dense

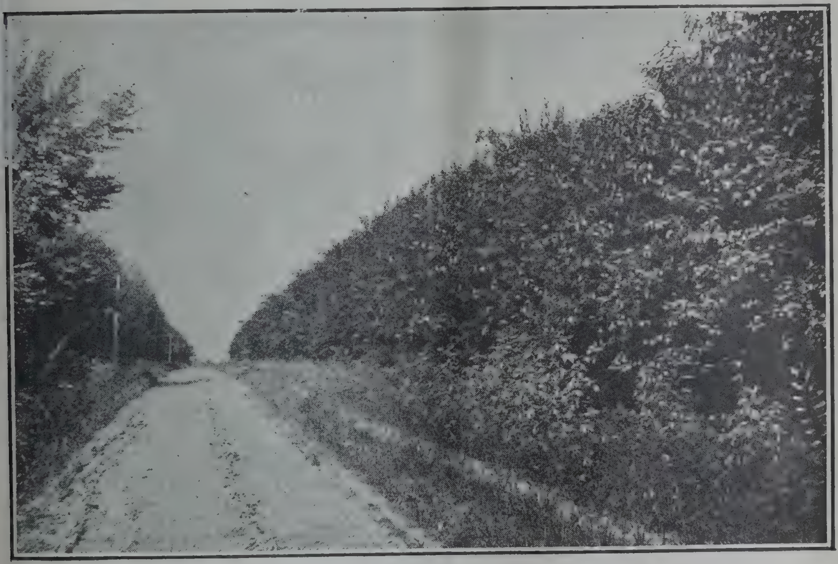


Fig. 6.—Osage orange windbreak, 12 years old. Monroe County, Iowa.

grove of trees. Accordingly, very close spacing can not be practice there unless irrigation is possible.

The approximate spacing considered generally desirable for th more promising species is shown in Table 4. To meet a specific condition of soil or climate, some other spacing may be better. Befor planting, it is advisable to write to the State forester concerning th matter.

TABLE 4.—*Spacing for forest trees.*

Kind of trees.	Spacing for woodlot.	Spacing for two-row wind-break.	Kind of trees.	Spacing for woodlot.	Spacing fo two-row wind-break.
	Feet.	*Feet.*		*Feet.*	*Feet.*
Green ash	6 by 6	4 by 8	Honey locust	8 by 8	....
White ash	6 by 6	....	Hard or sugar maple	6 by 6	....
Basswood	6 by 6	....	Silver maple	6 by 8	4 by 8
Black birch	6 by 6	....	Russian mulberry	....	4 by 8
Yellow birch	6 by 6	....	Red oak	6 by 6	....
Boxelder	....	4 by 8	White oak	6 by 6	....
Hardy catalpa	7 by 7	....	Osage orange	....	2 by 8
Black cherry	6 by 6	....	Red gum	8 by 8	....
Cottonwood	10 by 10	4 by 10	Sycamore	8 by 8	....
White elm	6 by 8	....	Black walnut	6 by 8	....
Eucalyptus (blue gum)	10 by 10	4 by 10	Yellow poplar	10 by 10	....
Hickory	6 by 6	....	White willow	8 by 8	3 by 8
Black locust	6 by 6	....	Yellow willow	8 by 8	3 by 8

Table 5 shows the number of trees required to the acre for th spacings given.

TABLE 5.—*Trees required to the acre with spacing indicated.*

Spacing in feet	10 by 10.	8 by 8.	6 by 8.	6 by 6.	4 by 8.	4 by 6 or 3 by 8.	4 by 4 or 2 by 8.
Number of trees required to the acre.	436	680	908	1,210	1,361	1,732	2,72

CARE OF PLANTATION.

CULTIVATION.

Though cultivation is not absolutely essential in all cases, particularly on loose soils in the regions where hardwoods thrive naturally, it is nearly always beneficial to a plantation, and especially so during the first several years of its existence. Cultivation is essential to success in regions of little rainfall where irrigation can not be practiced and on areas heavily sodded with grass. A heavy sod practically insures the failure of a young hardwood plantation. Horse cultivation is entirely practicable. If desired, some agricultural crop, such as potatoes, may be grown between the rows of trees during the early period of the plantation's growth. Cultivation should be given two or three times a year.

Forest trees are subject to damage by heavy frosts and, if they are growing vigorously when these frosts occur, they may be severely njured. Late cultivation induces late growth; there should be no cultivation, therefore, after the middle of the growing season.

CLEANING AND LIBERATION CUTTINGS.

When a piece of cut-over land is planted, it may happen that the natural brushy growth present will for a few years outgrow the planted trees, overtop them, or crowd them so as to interfere seriously with their development. In such a case, it will be necessary, perhaps for two or three successive years, to lop off this brush with a knife, pruning shears, or other sharp instrument.

When there are old trees with wide-spreading crowns on areas to be planted, it will be desirable to remove these trees a few years after the small trees are set out. Otherwise, because of the shade, the small trees will not develop satisfactorily.

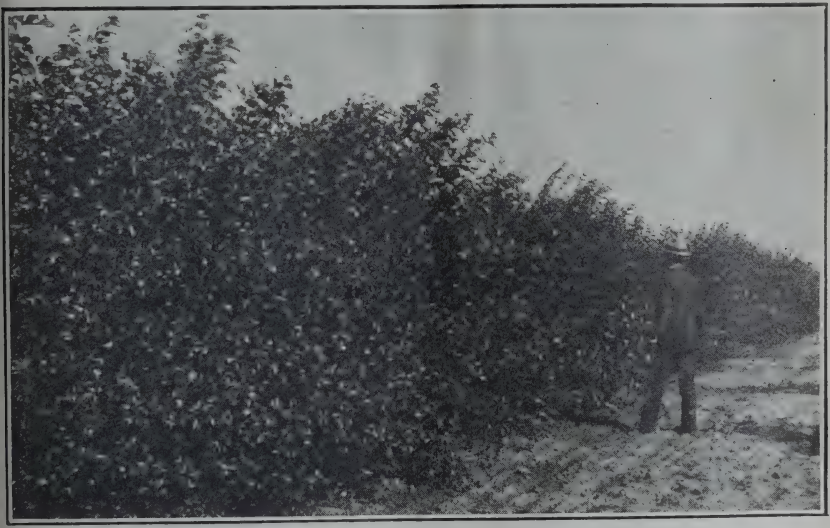


FIG. 7.—Russian mulberry windbreak, 5 years old. Graham County, Kans.

THINNING.

To produce clean-bodied timber, close spacing is desirable. When the tops of the trees begin to intermingle and crowd each other, however, they become like an overcrowded stand of vegetables in a garden. Growth is stagnated. A good gardener would pull out a portion of the vegetables in a garden that had reached this condition. When trees have reached a similar condition some of them should be cut out. In both cases, the result is the best development of the remaining portion rather than a poor development of the original number. The best-formed, most valuable, and most healthy trees should be selected to remain, and the others that are likely to interfere with their growth should be removed.

Thinnings are usually necessary by the time a plantation reaches the age of 20 years, sometimes sooner. Thinning may be done at odd times by the owner of the plantation at no other cost than his labor. Care should be exercised that the openings in the crown cover of the stand made by removing trees are no larger than may be closed in from three to five years by the growth of the remaining tree tops. When poles are cut for some farm use, a crude form of thinning may be secured by a little care in the selection of trees with a view to the betterment of the stand.

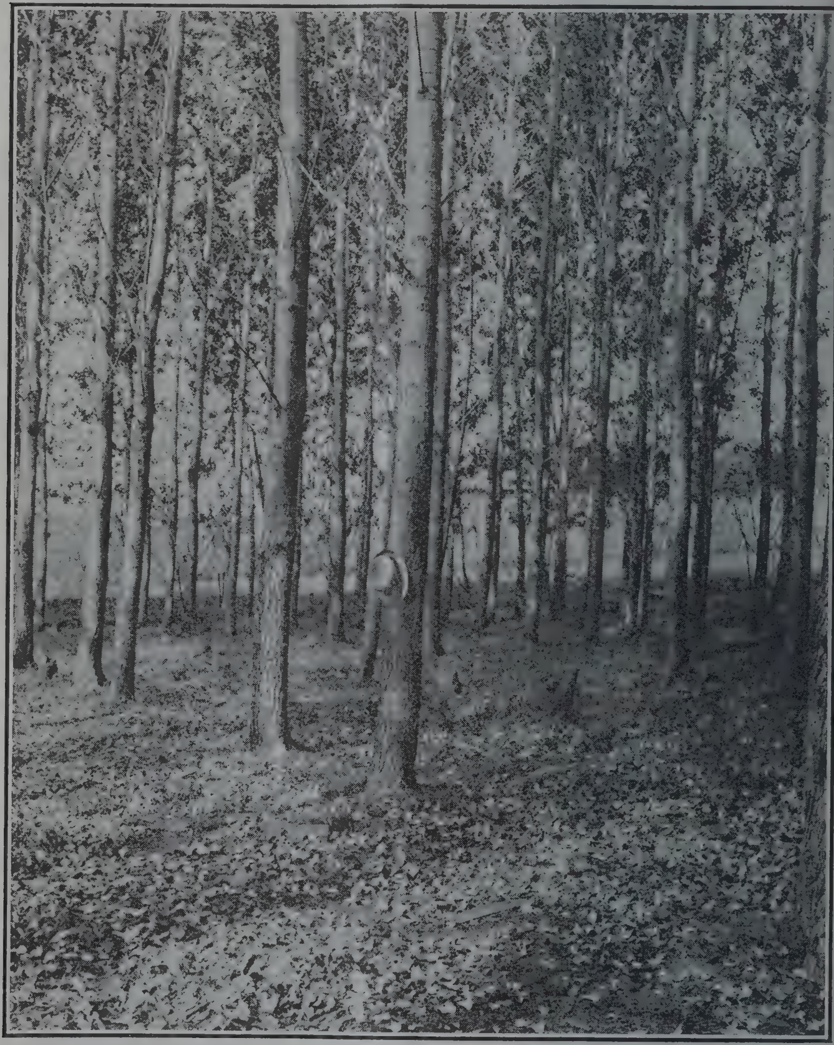


FIG. 8.—Cottonwood plantation, 12 years old. Trees 8 inches in diameter, 50 feet in height. Faribault County, Minn.

PRUNING.

Pruning of the branches of trees in a plantation is usually unnecessary and, because of the cost of the labor involved, undesirable. If spaced closely enough, most forest trees in plantations will prune themselves. Sometimes it will be profitable, in a stand that is intended to produce lumber, to prune the best trees by simply knocking off with an ax such dead and brittle limbs as can be reached.

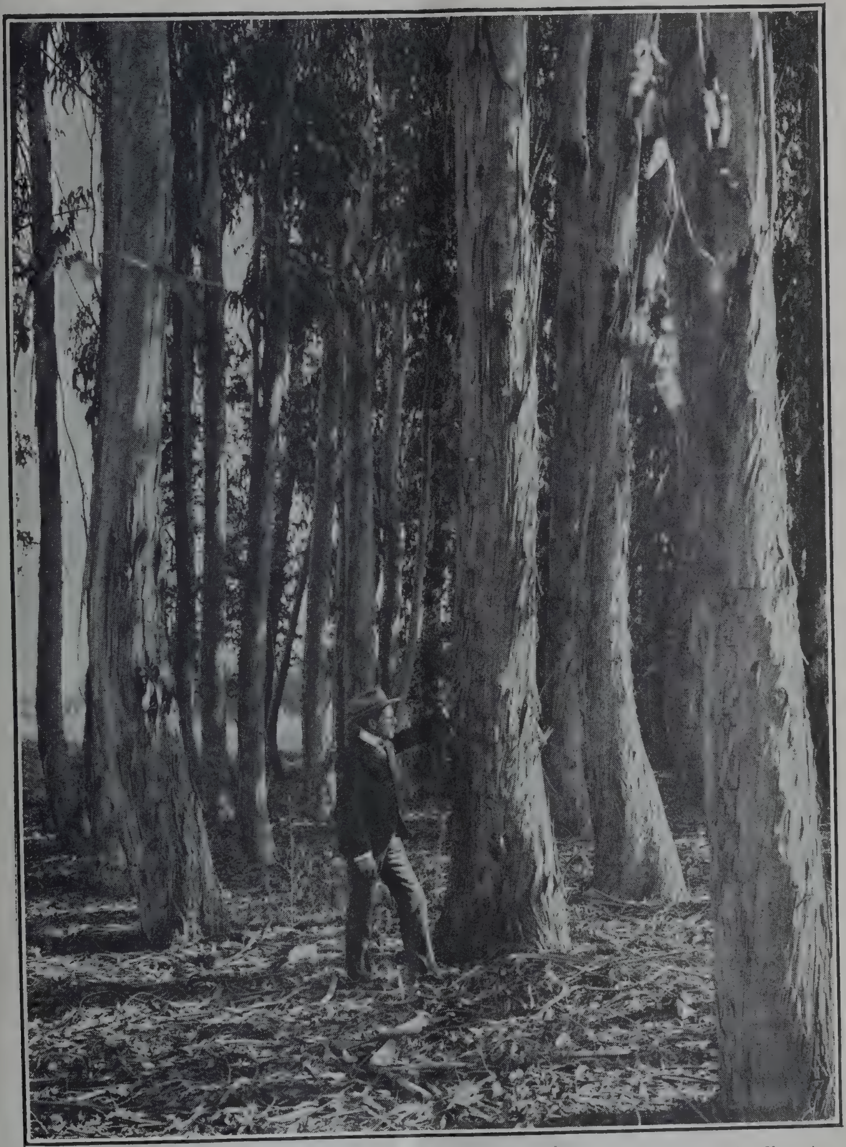


FIG. 9.—Blue gum (*Eucalyptus globulus*) plantation, 28 years old. Trees 14 inches in diameter. Los Angeles, Calif.

Occasionally, dead branches of black walnut trees persist for a number of years, and they are likely to form loose knots. The same is true of catalpa, which, moreover, is subject to serious attack by a fungus around the base of these loose dead branches. Such branches of both species should be removed. If, because of wide spacing or for some other reason, the trees are assuming a poor timber form, it may be necessary to correct the condition by pruning.

If pruning is undertaken it should be conducted during late winter or early spring, and should not be overdone.

If a tree is pruned too far up, it may become top-heavy and be easily broken off by a severe wind. Catalpa, ash, and black cherry in plantations are known to have suffered from this, and it seems likely that the same thing is true of many other species.

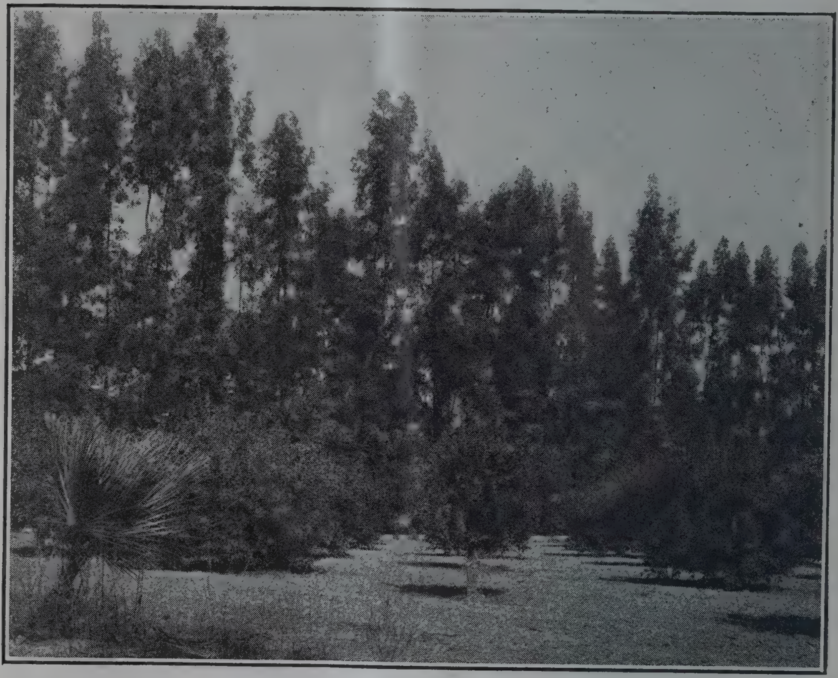


FIG. 10.—Blue gum (*Eucalyptus globulus*) windbreak, sheltering a lemon orchard. San Bernardino County, Calif.

PROTECTION.

Plantations should be protected against fires and grazing. Fires will kill young trees and injure old ones. Live stock of all kinds should preferably be excluded from a plantation at all times and particularly when the trees are small. The animals almost invariably cause damage to the trees by nipping off the branches, peeling the bark, trampling the roots, or trampling the small trees themselves. If the shade of the trees is a necessity for the animals, they should at least be restricted to a limited area of the plantation. In case the trees are being injured by insects, animals, or diseases, a remedy should be sought by inquiry of the United States Department of Agriculture or the State Agricultural College.

SOURCES OF PLANTING STOCK.

Private nurserymen are usually able to supply planting stock of the more important forest trees. The Forest Service will supply lists of these nurserymen upon request. In the following States forest tree nursery stock of some species for forest (not landscape) planting within the State may be obtained through the service indicated.

Sources of forest tree stock.

Idaho	School of Forestry, Moscow, Idaho.
Kansas	Fort Hays Experiment Station, Hays, Kans.
Kentucky	Commissioner of Agriculture, Frankfort, Ky.
Maine	State Forest Nursery, Orono, Me.
Maryland	Maryland State Board of Forestry, Baltimore, Md.
Massachusetts	State Forester, Boston, Mass.
Michigan	State Forester, Grayling, Mich.
Michigan	Michigan Agricultural College, East Lansing, Mich.
Montana [1]	Mandan Experiment Station, Mandan, N. Dak.
New Hampshire	State Forester, Concord, N. H.
New York	Conservation Commission, Albany, N. Y.
North Dakota [1]	Mandan Experiment Station, Mandan, N. Dak.
North Dakota	State School of Forestry, Bottineau, N. Dak.
Ohio [2]	State Forester, Wooster, Ohio.
Pennsylvania	Pennsylvania Department of Forestry, Harrisburg, Pa.
South Dakota [1]	Mandan Experiment Station, Mandan, N. Dak.
Vermont	State Forester, Montpelier, Vt.
Virginia	State Forester, University, Va.
Wisconsin	Conservation Commissioner, Madison, Wis.
Wyoming [1]	Mandan Experiment Station, Mandan, N. Dak.

SEED COLLECTION, EXTRACTION, AND STORAGE.

SEED COLLECTION.

Nearly any kind of tree seed can be bought from commercial seed houses, but often it may be cheaper and otherwise more advantageous to collect it near home. The collected seed will certainly be fresh, and the seedlings grown from it should be perfectly hardy so far as the climate is concerned.

TIME TO COLLECT.

Seed should be collected when ripe. For most kinds this means during autumn. Collecting may be extended into the winter for such species as the ashes, catalpa, honey locust, sycamore, and any others that retain the seed on the trees until that time. A few kinds of seed ripen during the spring or summer and must, of course, be collected at that time. Seed of such species as willow and cottonwood, which scatters soon after ripening, must be gathered promptly. Seed which hangs on the tree for a considerable period, such as that of ash and sycamore, may be gathered more at leisure.

---

[1] The Mandan Experiment Station furnishes stock only to residents of eastern Montana and Wyoming and western North and South Dakota.

[2] Nursery stock is distributed in Ohio only for demonstration or experimental purposes.

TABLE 6.—*Seed which ripens in spring or summer.*

Species.	Time of ripening.[1]
Elms (all species except cedar elm and southern red elm)	March to June.
Silver maple	April, May.
Red maple	April to June.
River birch	May, June.
Willows	March to June.
Poplars	April to July.
Mulberry	June to August.
Cherries	June to September.
Plums	July to September.

[1] As indicated by the dates, the time of ripening for any one species varies in different regions. In the South the ripening may occur in March, while in the cooler northern regions it may be deferred until June.

WHERE TO COLLECT.

Middle-aged trees growing in the open, in fence corners, or along roadsides, and with broad-spreading crowns ordinarily produce seed in greater abundance than those growing in dense forests. Trees of this kind, when they are of vigorous growth, are among the best sources of seed. On areas where trees are being felled for lumber or other uses splendid opportunities are often afforded for seed collecting. When the trees are felled, seed borne in their tops is easily gathered.

HOW TO COLLECT.

Tree seed must necessarily be picked by hand. Seed of the oaks, hickories, walnut, beech, chestnut, often that of the locust, and sometimes that of other species, may be gathered from the ground. The seed of such trees as the ashes, cherries, cottonwood, willow, hackberries, sycamore, and basswood, which clings to the branches, is picked from the standing trees or from those felled in lumbering operations. Pruning shears on a long pole or a home-fashioned iron hook, sharpened on its inner edge and fastened to a long pole, may often be used to advantage in clipping the seed from standing trees. Sometimes, with the aid of a hook or a rope thrown over a branch, the seed may be pulled down within reach. Professional seed gatherers often climb the trees to reach the seed.

SEED EXTRACTION.

The fruit of some hardwood trees requires special treatment to separate the seed from the fleshy covering, pod, or hull.

The fruit of osage orange, mulberry, the cherries, cucumber, holly, black gum, Kentucky coffeetree, honey locust, and others of a fleshy nature, needs to be macerated in water until the seed can be washed out. It should then be dried in a cool, shady place.

The fruit of the black locust readily yields its seed if it is placed in a sack or on a smooth surface and lightly flailed.

When fairly dry, the hulls of the pignut, shellbark, shagbark, and the mockernut hickories will fall off in handling. The thin hulls of other hickories need not be removed. The soft hulls of black walnut may be removed by hand, by running the nuts through a close-set cornsheller, or by allowing the nuts to lie on the ground in a sheltered place until the hulls rot or are destroyed by a small maggot that often attacks them. This maggot does no harm to the nut itself.

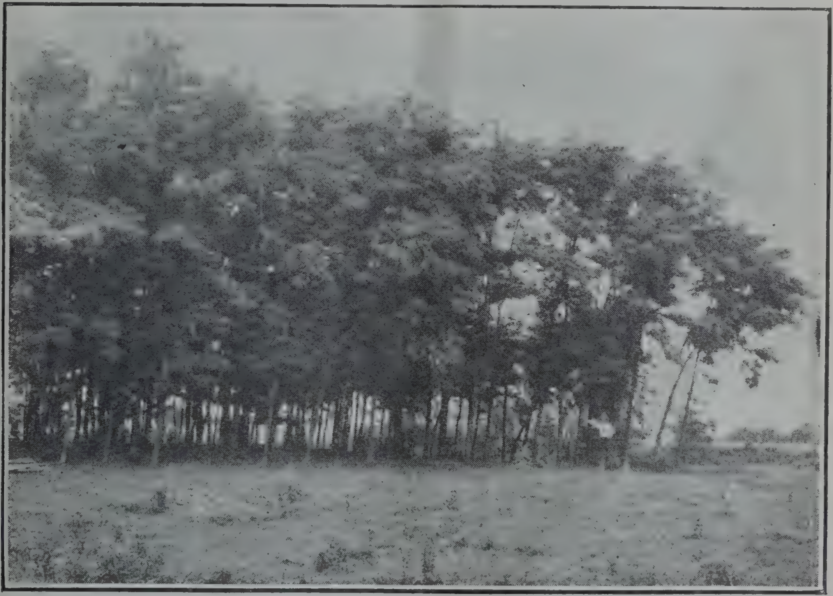


FIG. 11.—Black locust plantation, 9 years old. Trees 3 to 6 inches in diameter, 35 feet in height. Knox County, Ind.

SEED STORAGE.

The best time to sow seed, either in the nursery or on the permanent planting site, is soon after it is ripe. When this is not possible, the seed must be stored until spring. Seed that matures in the spring and early summer, that of the willows, poplars, most of the elms, river birch, and red and silver maples, does not retain its vitality well if stored. It should be sown as soon after ripening as possible. Most of the late-maturing hardwood seed may be successfully stored until the following spring.

The principal considerations regarding seed storage are that the seed must not be allowed to dry out excessively, because this impairs its power to germinate; and that it must not be kept at the same time moist and warm, because this induces premature germination, or molding and deterioration. Seed should not be stored in a warm place. Cold storage of some kind is essential.

COLD DRY STORAGE.

Some kinds of hardwood tree seed may be stored dry without deteriorating greatly, provided the temperature is constantly near the freezing point or lower. Among such is the seed of the catalpa, honey locust, osage orange, and boxelder. After the seed coat is thoroughly dried by exposure to the air for a few days, the seed may be placed in sacks and hung up out of the reach of rats, mice, squirrels and chipmunks, in some outbuilding or in the attic where the temperature will remain low through the winter.

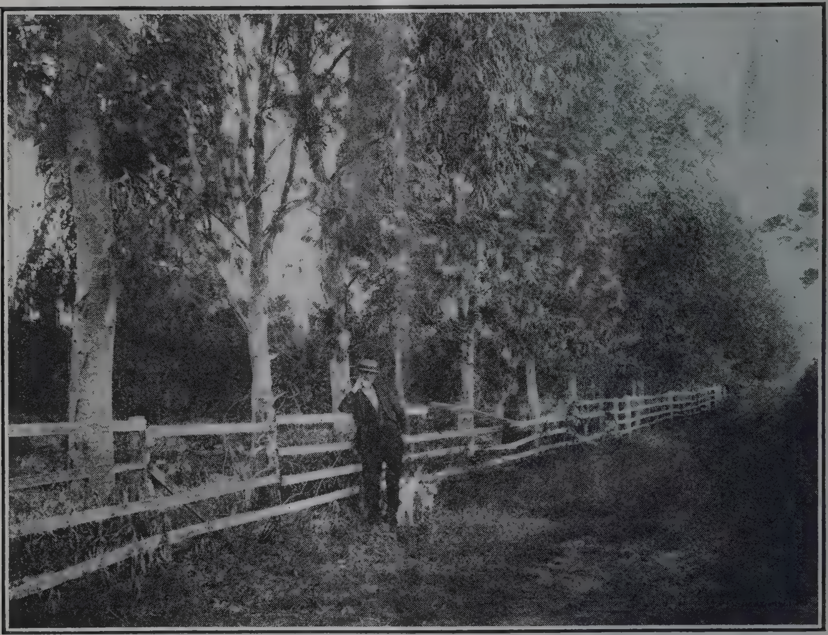


FIG. 12.—Red mahogany (*Eucalyptus resinifera*), 11 years old. Trees 14 to 18 inches in diameter, 60 to 65 feet in height. Brevard County, Fla.

COLD MOIST STORAGE.

Cold moist storage is probably the most suitable for all kinds of hardwood tree seed, provided the temperature can be kept at the freezing point or lower. Even seed that can be stored dry will, if stored under cold moist conditions, germinate more quickly when sown. Cold moist storage is particularly well adapted for the seed of walnut, oaks, hickories, chestnut, beech, basswood, sugar maple, and some other trees, the seed of which does not keep well if stored dry. If a large quantity of the nut seed is to be stored, it may simply be thrown on the ground after the advent of cold weather, in a layer 2 or 3 inches deep, and covered with sand, leaves, or forest litter, and then with a layer of dirt. The dirt should be rounded off so that water will not stand on it, and the whole pile may be covered with boards to prevent the soil from being washed away. It may be preferable to dig a shallow pit 6 inches or more in depth, in which to place the seed, and then use the same method of covering. In either case, the situation selected should be such that water will not collect and stand upon the pile.

When there is only a small quantity of seed, or when the seed itself is rather small, it may be stored in a box of moist sand. First, a layer of sand about 1 inch deep should be put in the box, then a layer of seed 1 inch thick, another layer of sand, and so on until the box is full. The box should be buried out of doors, at a depth of a foot or more, and covered with leaves and soil. A well-drained location should be chosen. In the spring the sand may be separated from the seed by screening. Very small seed, such as that of birch, may be placed loose in small cloth sacks and these alternated with layers of sand.

FIG. 13.—Lombardy poplar windbreak, 11 years old, 30 feet high. Finney County, Kans.

Seed stored in any one of these ways should be examined occasionally to see that it is not being disturbed by rats or mice. It must be watched very carefully in the spring, for, with the coming of warm weather, it is likely to germinate or to mold and heat. It must be sown either in the nursery or in the field at the very earliest possible opportunity after the frost is out of the ground in the spring.

Possibly the chief objection to both of these methods of storage out of doors is that most kinds of seed can be kept over only one winter, because with the coming of warm weather, the seed will begin to sprout. The seed of a few trees, however, such as the hawthorns, hollies, and black walnut, often does not germinate readily the next spring. This seed may be stored in moist sand in a cool place even until the second spring.

Table 7.—*Method of storage suitable for different kinds of tree seed.*

Cold and dry.[1]	Cold and moist.	Can not be stored; should be sown at once.
Birches.	Alder.	River birch.
Black locust.	Ashes.	Blue beech.
Boxelder.	Basswood.	Elms (except cedar elm and southern red elm).
Catalpa.	Beech.	Ironwood.
Black cherry.	Black gum.	Red maple.
Holly.	Black walnut.	Silver maple.
Honey locust.	Butternut.	Poplars.
Kentucky coffeetree.	Chestnut.	Willows.
Mulberry.	Cucumber.	
Osage orange.	Dogwood.	
	Cedar elm.	
	Southern red elm.	
	Hackberry.	
	Hawthorn.	
	Hickories.	
	Sugar maple.	
	Oaks.	
	Persimmon.	
	Red gum.	
	Sycamore.	
	Yellow poplar.	

[1] While the species listed in this column will withstand cold and dry storage, cold and moist storage would be preferable for most of them.

GROWING THE SEEDLINGS.

While some hardwood seedlings may be grown without great difficulty, the production of others, such as the eucalypts, should be left to the professional nurseryman. If a man's time and the actual expense connected with growing hardwood seedlings are considered, it may often be no cheaper to grow than to buy them. When home-grown, however, the seedlings are at hand when wanted, and this is a distinct advantage.

LOCATION OF SEED BEDS.

The seed beds should be located in good, well-drained, preferably loamy soil, in any convenient place. Proximity to woods or brushy areas should ordinarily be avoided, because these places harbor mice, chipmunks, or squirrels, which may disturb the seed. Proximity to the farm dwelling is desirable, because rodents are less likely to be abundant there.

PREPARATION OF SEED BEDS.

As with beds for vegetable crops, the soil should be spaded or plowed up and then well pulverized with harrow or rake. The smaller the seed to be sown the more thorough should be the preparation of the soil. Fall plowing, followed by spring spading and raking, will result in the soils being more mellow than if spring spading and raking only are practiced. Thorough preparation of the beds will result in better germination of the seed and better growth of the seedlings.

SOWING THE SEED.

METHOD.

Although in commercial operations the practice of broadcasting hardwood seed of many species is often followed, it is believed that in a small farm nursery it will ordinarily be more satisfactory to sow most kinds of seed in drills. These drills may be 2 or 3 feet apart to permit horse cultivation, or they may be spaced as closely as 10 or 12 inches. In the latter case, hand cultivation will be necessary. Those trees which may need shade (p. 27) should be grown in closely spaced rows. Less work and expense will then be entailed in providing the shade than is necessary when the rows are 2 or 3 feet apart.

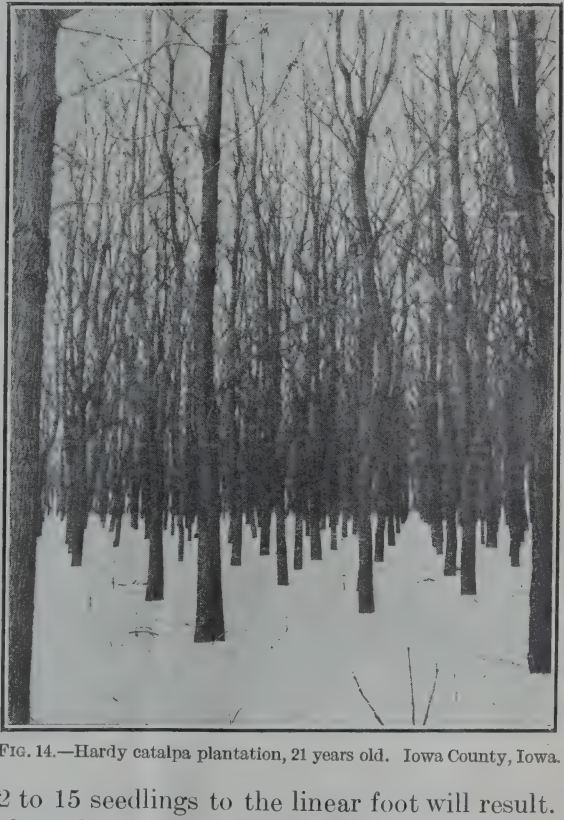


FIG. 14.—Hardy catalpa plantation, 21 years old. Iowa County, Iowa.

The seeds should be sown at a depth equal to two or three times their own thickness and close enough in the drill so that from 12 to 15 seedlings to the linear foot will result. Ordinarily, the drill need not be more than half an inch wide. In some cases, however, a drill of that width will result in crowding the seed. This is true for the seed of yellow poplar, only a small proportion of which sprouts (see Table 7); for seed with large wings, such as that of maples, catalpa, and ashes; and for seed of large size, such as that of walnut, butternut, chestnut, and some of the oaks. In all such cases the drills should be 2 or 3 inches wide, or wider if necessary, so that the seed may be distributed in them without crowding.

With small or thin seed, such as that of birch, elm, or sycamore, the best results, perhaps, will be secured by sowing broadcast and rather thickly over the beds, pressing the seed into the loose soil by means of a board, and covering it very lightly with soil and a light mulch of leaves or straw. Nearly any seed may be broadcasted, if that is desired.

THE USE OF SPROUTED SEED.

Because of the long taproot formed by the nut-bearing trees, and the consequent loss that ordinarily attends the transplanting of seedlings to the field, an experiment conducted by the Pennsylvania Forest Commission is of interest. Seed of white oak, black walnut, butternut, hickory, and red ash was stored over winter and stratified thinly in the spring. After the seed began to germinate and the root had developed to a length of from 2 to 4 inches, from 1 to 2 inches of this was pinched off. When the seed was planted, a very fibrous, stocky root system developed, the usual long taproot being absent.

NUMBER OF SEED TO SOW.

The number of seed to sow per foot depends upon the percentage of germination. This varies considerably, but Table 8 shows approximately the proportion for different species.

TABLE 8.—*Number of seed to sow per running foot of row to secure 15 seedlings to the foot.*

Kind of tree.	Proportion of seed that will sprout.	Number of seed to sow to the foot.	Kind of tree.	Proportion of seed that will sprout.	Number of seed to sow to the foot.
Yellow poplar	$\frac{1}{10}$	150	Honey locust	$\frac{7}{10}$	23
Sycamore	$\frac{3}{10}$	50	Oaks	$\frac{7}{10}$	23
Basswood	$\frac{1}{2}$	30	Beech	$\frac{3}{4}$	20
Maple	$\frac{1}{2}$	30	Black walnut	$\frac{3}{4}$	20
Mulberry	$\frac{1}{2}$	30	Butternut	$\frac{3}{4}$	20
Ash	$\frac{3}{5}$	25	Hardy catalpa	$\frac{3}{4}$	20
Boxelder	$\frac{3}{5}$	25	Black cherry	$\frac{3}{4}$	20
Kentucky coffeetree	$\frac{3}{5}$	25	Chestnut	$\frac{3}{4}$	20
Red gum	$\frac{3}{5}$	25	Hackberry	$\frac{3}{4}$	20
Black locust	$\frac{7}{10}$	23	Hickory	$\frac{3}{4}$	20
Elm	$\frac{7}{10}$	23	Osage orange	$\frac{3}{4}$	20

In the case of yellow poplar, for instance, which has a germination of only 10 per cent, it would be necessary to sow 150 seeds to the foot to obtain 15 seedlings. Only 50 seeds to the foot would be necessary for sycamore, which has a germination of 30 per cent.

The number of seeds to the pound of the more important species is about as follows:

TABLE 9.—*Approximate number of seed to the pound.*[1]

Kind of tree.	Number of seed to the pound.	Kind of tree.	Number of seed to the pound.
Arizona ash	13,000	Hackberry	2,600
Blue ash	7,000	Bitternut hickory	110
Green ash	16,000	Mockernut hickory	110
White ash	6,000	Pignut hickory	200
Basswood	6,000	Shagbark hickory	90
Beech	1,400	Shellbark hickory	80
Black or sweet birch	488,000	Honey locust	3,000
Yellow birch	425,000	Kentucky coffeetree	230
Paper birch	700,000	Red maple	18,000
Black gum	2,800	Silver maple	2,400
Black locust	27,000	Sugar maple	7,200
Black walnut	25–35	Russian mulberry	200,000
Boxelder	14,500	Chestnut oak	180
Butternut	16–40	Pin oak	380
Hardy catalpa	19,500	Red oak	125
Black cherry	4,500	Scarlet oak	260
Chestnut	100–150	Swamp white oak	160
Cottonwood	1,350,000	White oak	210
Cucumber	3,000	Osage orange	12,500
Red elm	54,000	Red gum	175,000
White elm	94,000	Sycamore	170,000
Eucalyptus (blue gum)	215,000	Yellow poplar	18,500

[1] Includes that portion of the fruit which is generally sown.

SEASON TO SOW.

Seed which ripens in the spring or early summer (see Table 1) should be sown at that time. That which ripens in the autumn may be sown then, or stored until spring. Fall sowing is in most regions preferable for all species, if the seed beds can be adequately protected against rodents. It is especially true for such seed as that of the chestnut or the white oaks, which may lose their vitality if stored over winter. Fall sowing should be deferred until just before cold weather sets in. If seed is sown early in the fall, and warm weather follows, the seed may sprout and later be killed by the cold of winter. Spring sowing should be done just as soon as the frost is out of the ground.

It is generally advisable to mulch fall-sown seed beds with 2 or 3 inches of forest leaves or litter. Straw may also be used. This mulch will prevent the rains from washing out the seed and will also prevent the ground from alternately freezing and thawing, and heaving out the seed. The mulch should be removed as soon as the seedlings begin to appear in the spring.

METHODS OF HASTENING THE GERMINATION OF SEED.

Seed coats which are nearly impermeable to water are often the cause of delay in sprouting. Fall sowing, or the cold moist storage of the seed over winter, gives a long period for absorbing moisture. The seed will then usually sprout promptly the following spring or summer. Sprouting is sometimes hastened by soaking the seed for several days in *cold* water. If stored dry and intended for sowing in the spring, the bony-coated seed of black locust, honey locust, and Kentucky coffeetree, just before sowing, should be placed in water heated nearly to the boiling point. After the seed has swollen, it should be removed and sown at once. The operation should be repeated for the seed which does not swell on the first immersion.

FIG. 15.—Black walnut plantation. Indiana.

LENGTH OF TIME REQUIRED FOR SPROUTING.

Some seeds sprout in a few days, others not for several weeks, and still others often not until the second season, particularly if they are stored dry over winter and then sown in the spring. Among those which are likely to lie over for a year are basswood, holly, black locust, Kentucky coffeetree, and honey locust. If stored dry and sown in the spring, a portion of the seed of some trees may sprout the first year and an additional portion the following year. Among these are hackberry, blue beech, ironwood, cucumber, black walnut, beech, osage orange, black cherry, white ash, boxelder, cucumber tree, yellow poplar, sycamore, and sugar maple.

CARE OF SEED BEDS.

WATERING.

If water is available and can easily be applied, it is advisable to keep the seed beds moist until the seeds sprout, and later to water the seedlings when the beds become dry. It will usually be unnecessary to water seed sown in the fall. Such seed will absorb moisture during the winter and with the coming of warm spring weather will sprout quickly. Watering of the seedlings should be discontinued after midsummer, in order that they may harden up properly before the fall frosts.

PROTECTION.

Seed beds must, of course, be protected against live stock and sometimes against field mice or other rodents. Two or three house cats usually afford some protection against the latter, but sometimes resort must be had to small traps. If birds become troublesome they must be scared away or shot.

SHADING.

Seedlings of most hardwood trees will need no shade in the seed beds; but those of the beech, birch, red gum, white ash, sugar maple, slippery or red elm, hackberry, and mulberry, are likely to be damaged by intense sunlight, and, when this appears to be the case, should be supplied with partial shade. A covering of brush or tree branches in leaf will usually be sufficient. If this is lacking, shade frames of some kind that will cut off about half of the sunlight from the seedlings should be constructed. Some nurserymen use shade frames made by nailing lath spaced about 1½ inches apart on a rectangular frame. The growing of such seedlings under somewhat open woods should prove successful.

WEEDING AND CULTIVATION.

The beds should be weeded and cultivated several times during the growing season. Horse cultivation may be practiced where the rows are spaced widely. In beds seeded broadcast cultivation is, of course, impracticable.

REMOVING SEEDLINGS FROM SEED BEDS.

Hardwood seedlings 10 inches or more in height are large enough for field planting. Most of them reach this size in one growing season. Some, including the seedlings of black cherry, cucumber tree, yellow poplar, basswood, sugar maple, red gum, black gum, red mulberry, birch, and beech, may have to remain in the seed beds two years or more. In digging them from a farm nursery the spade is the most effective tool. Care should be taken to injure the roots as little as possible, and to secure practically all of them. Injured portions of the roots should be cut off with a sharp knife. The seedlings should not be dug until the time for planting them in their permanent locations. Digging them and exposing the roots to the air for some time may kill them. Even when they are being transported to the planting site, the roots should be covered with wet burlap, wet straw, moss, or other similar material.

SOURCES OF INFORMATION AND ADVICE FOR THE PLANTER.

Many of the States now have forestry departments. A few have forest extension specialists. The men connected with the work are familiar with local conditions, and are able and willing to answer inquiries concerning planting or other forestry problems from people residing in the State. In some cases they can arrange to visit a farm and give advice on the ground. The addresses of these forestry departments or officers follow:

Sources of information concerning tree planting.

Alabama	State Commissioner of Forestry, Montgomery, Ala.
California	State Forester, Sacramento, Calif.
Colorado	State Forester, Fort Collins, Colo.
Connecticut	State Forester, New Haven, Conn.
Georgia	Forestry Department, Georgia State College of Agriculture, Athens, Ga.
Idaho	State Land Commissioner, Boise, Idaho.
Idaho	School of Forestry, Moscow, Idaho.
Indiana	State Board of Forestry, Indianapolis, Ind.
Iowa	State Forestry Commission, Des Moines, Iowa.
Iowa	Forestry Department, Iowa State College of Agriculture, Ames, Iowa.
Kansas	State Forester, Manhattan, Kans.
Kentucky	Commissioner of Agriculture, Frankfort, Ky.
Louisiana	Superintendent of Forestry, Conservation Commission, New Orleans, La.
Maine	Forest Commissioner, Augusta, Me.
Maryland	Maryland State Board of Forestry, Baltimore, Md.
Massachusetts	State Forester, Boston, Mass.
Michigan	State Forester, Grayling, Mich.
Michigan	Forestry Department, Michigan Agricultural College, East Lansing, Mich.
Minnesota	State Forester, St. Paul, Minn.
Montana	State Forester, Helena, Mont.
New Hampshire	State Forester, Concord, N. H.

New Jersey	State Forester, Trenton, N. J.
New York	Superintendent of Forests, Conservation Commission, Albany, N. Y.
North Carolina	Forester, Geological and Economic Survey, Chapel Hill, N. C.
North Carolina	Forest Extension Specialist, North Carolina College of Agriculture and Mechanic Arts, West Raleigh, N. C.
North Dakota	State Forester, Bottineau, N. Dak.
Ohio	State Forester, Wooster, Ohio.
Oregon	State Forester, Salem, Oreg.
Pennsylvania	Pennsylvania Department of Forestry, Harrisburg, Pa.
Rhode Island	Commissioner of Forestry, Chepachet, R. I.
South Dakota	Forest Supervisor, Commissioner of Schools and Public Lands, Custer, S. Dak.
Tennessee	Forester, State Geological Survey, Nashville, Tenn.
Texas	State Forester, College Station, Tex.
Vermont	Chief Forester, Montpelier, Vt.
Virginia	State Forester, University, Va.
Washington	State Forester, Olympia, Wash.
West Virginia	Forest, Fish, and Game Warden, Philippi, W. Va.
Wisconsin	Conservation Commissioner, Madison, Wis.

○

5.

THE BROWN-SPOT OF CORN WITH SUGGESTIONS FOR ITS CONTROL

W. H. TISDALE
Pathologist in Cereal-Disease Investigations
Office of Cereal Investigations

FARMERS' BULLETIN 1124
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C.
October, 1920

Show this bulletin to a neighbor. Additional copies may be obtained free from the Division of Publications, United States Department of Agriculture

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920

THE PURPOSE of this bulletin is to familiarize the farmer with the appearance, distribution, nature, and economic importance of the brown-spot of corn and to offer certain helpful suggestions for its control.

The leaf blades of diseased plants have a rusty appearance which differs from that of a true rust. On the leaf sheath and stalk diseased areas are larger than on the blades and are darker in color (see figs. 1 and 2). Diseased plants turn yellow and may finally break over at the lower nodes.

The disease is present throughout a large part of the corn-growing section east of the Rocky Mountains, but is most prevalent and destructive in the South Atlantic and Gulf Coast States.

Damage caused by the disease may amount to 10 per cent of the crop, but the average loss is considerably lower.

High temperature in combination with high humidity favors the development of the disease. For this reason the damage is greater in the South, where high temperatures prevail throughout the summer and the rainfall is rather heavy.

The disease is caused by a minute fungous parasite, which enters through the epidermis of the plant, invades the tissues, and produces numerous spores in the cells of the corn plant. These spores germinate the following season to produce a new crop of the fungus.

Careful field sanitation, crop rotation, and seed selection aid in controlling the disease.

THE BROWN-SPOT OF CORN, WITH SUGGESTIONS FOR ITS CONTROL.

CONTENTS.

	Page.		Page.
Regional distribution of the disease	3	Factors influencing the development of the disease	6
Description of the disease	3	Crops diseased	7
Distribution and prevalence of the disease	3	Cause of the disease	7
Damage caused	4	Control measures	9
Symptoms	4		

REGIONAL DISTRIBUTION OF THE DISEASE.

CONSIDERABLE DAMAGE is caused to the corn crop of the South by the brown-spot (Physoderma) which was discovered in India in 1910 and in the State of Illinois in 1911. The disease has been found over a large part of the corn-producing sections of the United States since that time. It is abundant throughout the South Atlantic and Gulf States and is doing considerable damage in that section.

DESCRIPTION OF THE DISEASE.

The disease is characterized by the appearance of brown spots on the leaf, leaf sheath, and stalk (figs. 1 and 2), and in rare cases it has been seen on the outer husks of the ears. The spots usually are more abundant on the lower half of the plant. From a distance, diseased plants have a rusty appearance, especially if the blades are diseased. Diseased leaf sheaths and stalks are identified by darker spots, which may be almost black in color.

DISTRIBUTION AND PREVALENCE OF THE DISEASE.

Brown-spot is a serious disease of corn occurring abundantly throughout the southeastern part of the United States and known to occur as far west as central Texas. It is found as far north as South Dakota and southern Minnesota and eastward to central New Jersey. It is most prevalent in the South Atlantic and Gulf Coast States and in the lower Mississippi Valley, where there is a high degree of humidity with a relatively high temperature. These factors favor the development of the disease.

DAMAGE CAUSED.

Damage caused by the disease is usually local, owing to the fact that its development is closely connected with weather conditions, which vary in different localities and in any one locality in different seasons. The most pronounced losses have been caused along the South Atlantic and Gulf Coast States and in the lower Mississippi Valley. In the lowlands of North Carolina and South Carolina and in the Gulf and Delta sections of Mississippi frequent reports of as much as 5 per cent loss have been received. In some cases the damage was estimated at 6 to 10 per cent of the crop. The writer visited a few fields in the eastern part of South Carolina where the damage was perhaps as much as 10 per cent. Fields so badly injured were seldom found, however. These estimates were based entirely on grain loss. The fodder is often injured very badly. Besides the areas mentioned above, where the damage is more or less general, are low wet areas throughout the South and as far north as southern Illinois, where damage has been caused by the disease.

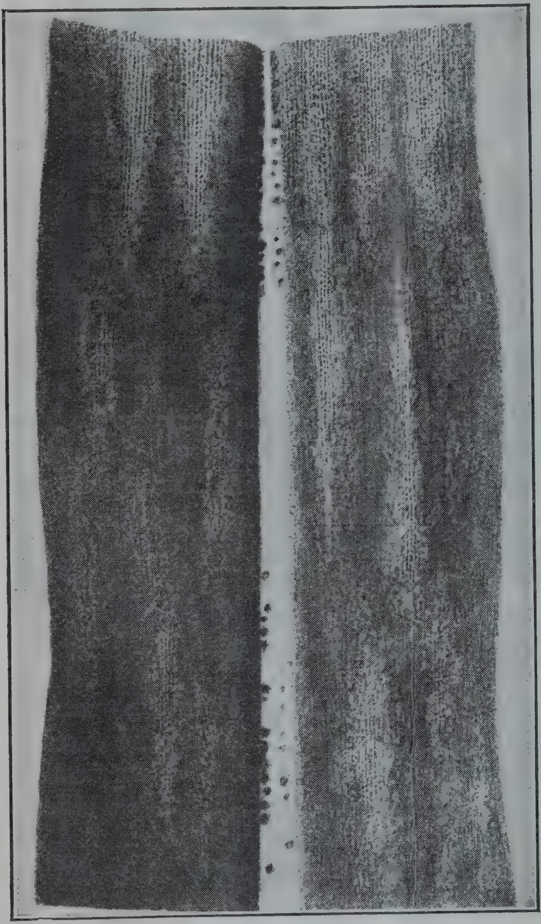


FIG. 1.—Corn leaf showing brown-spot on blade and midrib.

SYMPTOMS.

The disease in its first appearance on the leaf blades (fig. 1) resembles the early stages of the true corn rust. The latter, however, is characterized by an open pustule and has an entirely different cause. Rust is confined largely to the leaf blades and causes little damage to the corn crop where it is present.

Brown-spot first appears as slightly bleached or yellowish spots which become darker within a few days (fig. 1). This darkening continues until the spots are brown to reddish brown with a somewhat lighter margin. They are very small (one-twenty-fifth of an inch in diameter), but may be so numerous as to give the blade a rusty appearance. For this reason the disease is often considered a true rust by those who are not familiar with its nature. This rusty appearance is not uncommonly seen in bands across the leaf blades. On the midrib of the leaf blade (fig. 1) and on the leaf sheath (fig. 2) the spots are considerably larger than on the thin parts of the blades (fig. 1). Often a single spot will measure one-fourth of an inch in diameter. These spots are irregular in shape and sometimes may be almost square in outline. In the early stages of development they appear as dark-green areas, somewhat darker than the normal tissue surrounding them. After a few days they become dark brown in the center. This change in color spreads until the entire spot is dark or chocolate brown. These diseased areas are often so numerous as to run together and cause the entire sheath to become brown and decayed. Sometimes the entire leaf is killed before the plant is mature. The disease is usually more abundant on the parts of the sheath which are beneath the overlapping parts where the moisture is held.

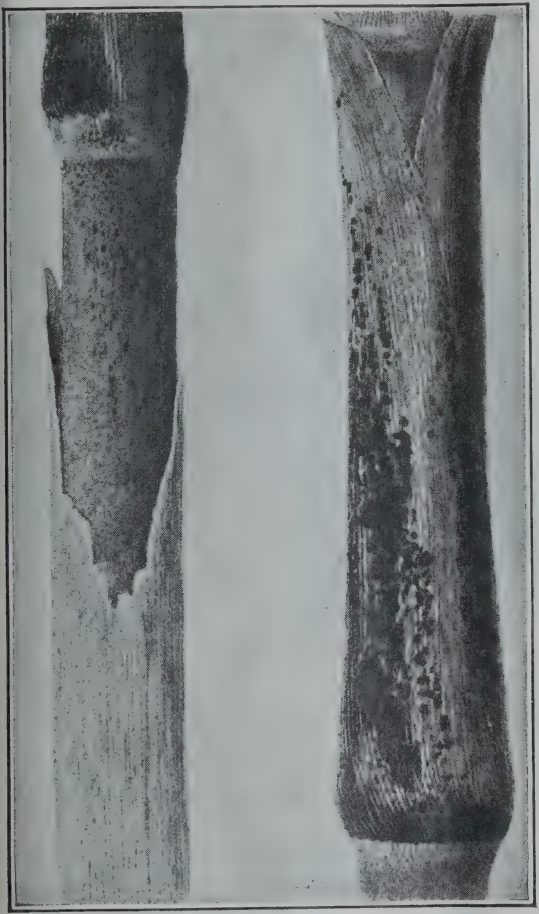


FIG. 2.—Cornstalk and sheath showing brown-spot.

The brown-spot disease is often accompanied by a red color of the sheath and midrib, especially the latter, which may almost entirely hide the brown color. After the plants begin to mature the epidermis (skin) over the spots becomes loose and they appear as brown blisters. These blisters are easily broken when dry and a brown spore dust is liberated. The tissues in the invaded areas are so completely destroyed as to leave only a shredded mass of loose fibers.

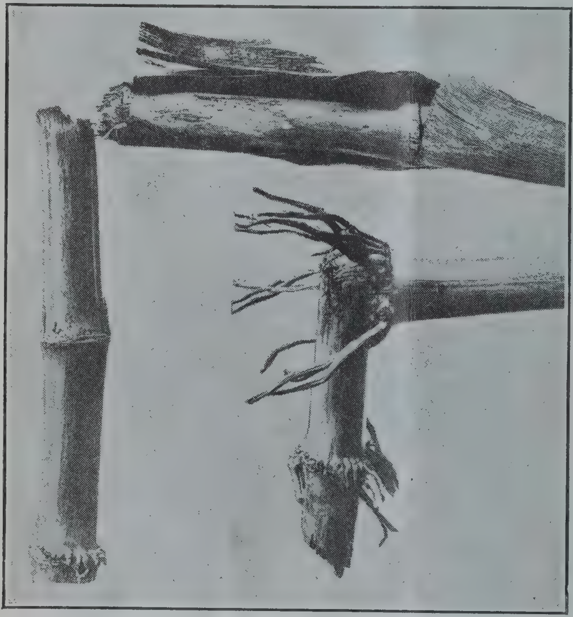


Fig. 3.—Badly diseased cornstalks broken over at the infected and weakened lower joints. These are the effects of the disease where it is the most destructive. (Photographed by Prof. J. M. Beal.)

On the stalks (fig. 2) the spots are very much like those on the sheath (fig. 2) and midrib (fig. 1). They usually are more numerous at the nodes and just below the nodes where free water is held by the sheath. The stalks often are completely girdled at the nodes and are easily broken by winds (fig. 3). In the South the disease is responsible for considerable lodging of corn in the early stages of maturity. The plants usually break at the lower nodes, where the disease is worst. The pith of the broken stalks often is brown and decayed. Considerable damage may be caused by the breaking of plants in this way.

FACTORS INFLUENCING THE DEVELOPMENT OF THE DISEASE.

A high temperature with a moist atmosphere favors the development of the disease. If these conditions occur before the corn plants are more than half grown the disease may do considerable damage. The following facts have been learned regarding these weather conditions:

(1) Serious injury has been confined largely to the South, where the summer temperature is continuously high, and to localities in which there has been considerable rainfall during the early growth of the corn plants. Plants may become diseased in the later stages of growth, but the damage is not then

likely to be great. The warm summer showers, which may occur daily for a week or more, furnish ideal conditions for the development of the disease.

(2) Where seasons are dry the disease is more pronounced on corn growing near the water or on low, wet land where the atmosphere is moist. Under these conditions the foliage of the plants is less subject to drying by winds, and the necessary water for the development of the disease is retained.

(3) Where the early corn season is dry and the late season wet, the disease is more severe on late corn. When the early season is wet and the later period dry, however, early corn is most seriously injured, provided the temperatures are favorable for the development of the fungus.

(4) Apparently the more vigorous plants in certain cases are the most severely attacked. These plants, however, will not continue to look vigorous after the disease has had time to develop. The fact that these vigorous plants are capable of shielding the free water which is held inside the sheath and around the growing point, or bud, from the drying effects of the wind and sun offers more favorable conditions for attacks by the fungus and no doubt accounts for the greater percentage of infection on plants of this type. In low, wet fields small plants are injured the same as large ones. This greater injury to large, vigorous plants was more noticeable in dry territory.

(5) The disease was found on the Blue Ridge Mountains in North Carolina at an altitude of about 3,000 feet, where it is claimed that the summer nights are always cool. In 1917 corn foliage at this point was killed by frost on September 11. Very little of the disease was found, however, at this altitude, even on wet land. The low temperature, no doubt, is the limiting factor in its development. The disease must have a temperature not lower than 70° F. in order to develop at all, and it develops much more readily at temperatures ranging from 80° to 86° F. This probably accounts for the lack of serious injury to the corn crop farther north.

(6) The rare occurrence or absence of the disease farther west may be explained by the semiarid conditions which exist there, where a combination of moisture and temperature suitable for the development of the disease is seldom realized.

CROPS DISEASED.

The disease occurs on all varieties of corn (maize) and on teosinte, a near relative of the corn plant. It is possible that the fungus was introduced from Mexico or Central America with teosinte seed.

CAUSE OF THE DISEASE.

Brown-spot is caused by a minute fungous parasite. This parasite produces spores (fig. 4, *a*) in abundance within the cells of the corn plant. Like the seeds of higher plants, such as wheat, oats, and corn, these spores germinate to produce a new crop of the parasitic fungus that causes brown-spot. These spores are so small that a single one can not be seen with the naked eye. When grouped together in large numbers they appear as a brown mass. They live over winter on the old corn plants or in the soil and are carried by wind, water, insects, and other agencies, and perhaps on the seed corn, and are deposited in the buds of the young corn plants the following spring. When the weather becomes warm and the early summer showers begin, these spores germinate (fig. 4, *b* to *f*) and produce a large number of very small zoospores (fig. 4, *g*), or swimming spores, which swim around in the water for an hour or more and then come to rest on the surface of the corn plant. These small swimming spores, after settling on the surface of the plant, germinate by sending out fine, threadlike fibers (fig. 4, *h*) which penetrate the epidermis of the plant and grow into the cells beneath, thus causing the disease. After a few days the larger brown spores are produced in abundance within the invaded cells of the plant. This new crop of spores serves to carry the fungus over winter again. Spores have been found to live two years on old plants, both above and below the soil surface.

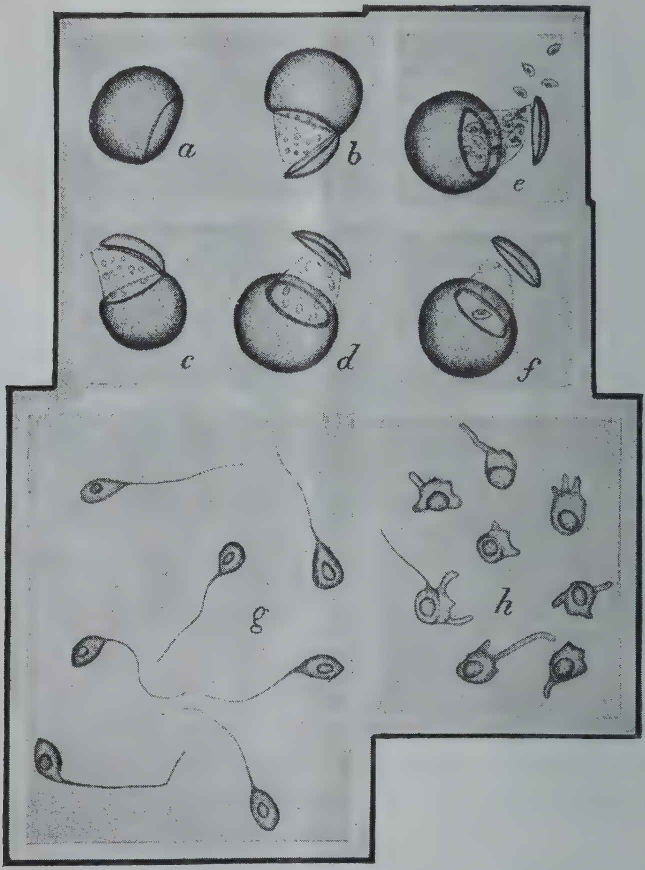


FIG. 4.—Two kinds of spores of brown-spot: *a* to *f*, Spores producing zoospores; *g*, zoospores; *h*, germinating zoospores.

CONTROL MEASURES.

(1) Cut the diseased plants as fine as possible with a stalk cutter and turn under deep enough so that they will not be disturbed by ordinary cultivation the following season. This eliminates a large part of the spore material for that year. If possible this material should not be plowed up for at least two years, as the spores live at least that long in the soil.

(2) Where the corn is used for silage or stover the plants should be cut early and as near the ground as possible, in order that a large part of the spores of the fungus may be removed. Barnyard manure containing these and other diseased corn products should not be used as fertilizer on land to be planted to corn and should not be put on land where the disease has not been known to occur previously.

(3) Crop rotation has a tendency to reduce the amount of injury caused by the disease. The most severe cases known have been on land where corn has been grown continuously for a number of years. In a system of rotation the cornfield should be located as far as possible from the area where corn was grown the previous year, as the spores are wind blown and a change of only a short distance would make little difference for this reason. The longer the period between corn crops in the rotation the better the results are likely to be.

(4) There are indications of the disease being started in certain localities from spores carried on the seed corn. It is hardly probable that there is any extensive distribution in this manner, owing to the fact that the spores carried on the seed would in all probability be buried with the seed and not have a chance to cause any trouble that season. No fungicide has been found that will penetrate the thick spore walls and kill the spores. In order to obtain seed corn free from spores, pick ears from disease-free plants or from plants as nearly disease free as possible. Gather the ears without husking and husk after they have been carried to some place where spores will not be blown on them after the husks are removed. This precaution should be taken especially when shipping seed corn to disease-free territory.

Farmers' Bulletin 1125
United States Department of Agriculture

B

FORAGE FOR THE COTTON BELT

THE FORAGE CROPS adapted to the cotton belt are mostly different from those utilized in the North and West, mainly on account of climate but partly due to soil.

Each important forage plant is described in sufficient detail to indicate its relative value and the points necessary to heed in its successful culture. In most cases references are made to Farmers' Bulletins of the Department giving more detailed cultural directions.

Meadows and haymaking are fully considered. A good hay plant should make a large growth, be leafy, have fine and tender stems, be palatable, and grow so erect that it can be cut readily with a machine.

The best hay made from any crop is always that which is made the most quickly and with the least exposure to sun and air.

Permanent pastures in the cotton belt should have as their foundation either Bermuda grass or carpet grass. Bermuda grass is best on all heavy soils, while carpet grass is superior on sandy or sandy loam soils. Lespedeza, bur clover, and Augusta vetch are important in mixture with the grasses.

The silo is of less importance in the cotton belt than in regions having shorter grazing seasons, but it is usually a profitable investment for the dairyman.

Soiling is often more economical than grazing, especially where land is expensive, as it enables the farmer to produce more feed from the same area of land.

Owing to the great number of forage crops adapted to the cotton region there is room for considerable difference of opinion as to the best sorts for use in any given locality. Definite recommendations of forage crops by the experiment-station authorities in the States included in the scope of this bulletin are given.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C.
Issued October, 1912
Revised May, 1920

FORAGE FOR THE COTTON BELT.

S. M. Tracy,

Agronomist, Office of Forage-Crop Investigations.

CONTENTS.

	Page.		Page.
Southern forage crops highly profitable	3	Hay crops	51
Soils	3	Pastures	56
Hay and pasture grasses	5	Silage crops	58
Coarse fodder grasses	23	Soiling crops	59
Legumes	28	Recommendations by the agriculturists of southern experiment stations	60
Miscellaneous forage crops	47		

SOUTHERN FORAGE CROPS HIGHLY PROFITABLE.

THE SOIL AND CLIMATE of the cotton-growing region are in the main so unlike those of other parts of the United States that different crops, and to some extent different methods of management, are necessary to secure the most profitable crops of forage for grazing, soiling, and haymaking. In this region Bermuda grass, Japan clover, velvet bean, beggarweed, Mexican clover, Rhodes grass, and a number of other forage plants which can not be grown elsewhere give highly profitable returns, while the common forage crops of more northern regions—timothy, red clover, bluegrass, and others—have little value. During the last 20 years much progress has been made in determining or finding the most valuable of the numerous forage crops adapted to the cotton-growing region and in the management of both meadows and pastures.

The climate in this region is so warm that growth continues nearly or quite throughout the year, so that it is possible to grow a great variety of forage crops suited to one season or another. The rainfall ranges from about 60 inches near the Gulf coast to about 40 inches at its northern limit. The frostless period of eight or nine months insures a very long season for pasturing.

SOILS.

The selection of the best forage crops for any given region is determined to some extent by the character of the soil. Based on soil, the cotton belt may be divided into rather distinct sections, at least so far as forage crops are concerned. (Fig. 1.)

The Piedmont Plateau.—The Piedmont area is extensive in the Carolinas, Georgia, and Alabama. The country is rolling and well drained, covered originally with timber, mostly of hardwoods. The soils are for the most part reddish clays or clay loams and usually are poor in humus. In general they lack cohesiveness and easily become gullied unless carefully handled. To prevent washing on slopes the practice of terracing farms is general. When skillfully managed the Piedmont soils are among the most productive in the South.

River valleys or flood plains.—Alluvial soils cover thousands of square miles along the Mississippi, extensive valleys along the Red, Pearl, and other large rivers, and smaller areas along nearly all the streams. Such soils are always very productive and along the larger streams are usually rich in lime, though this element is sometimes scanty in alluvial soils along the smaller streams which have their source in the upland clay or sandy pine region.

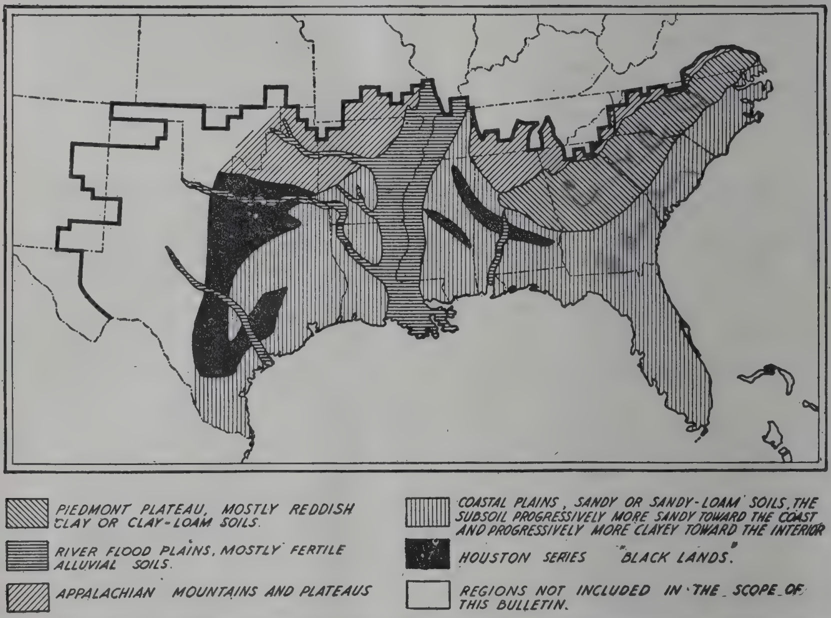

PIEDMONT PLATEAU, MOSTLY REDDISH CLAY OR CLAY-LOAM SOILS.
RIVER FLOOD PLAINS, MOSTLY FERTILE ALLUVIAL SOILS.
APPALACHIAN MOUNTAINS AND PLATEAUS
COASTAL PLAINS, SANDY OR SANDY-LOAM SOILS, THE SUBSOIL PROGRESSIVELY MORE SANDY TOWARD THE COAST AND PROGRESSIVELY MORE CLAYEY TOWARD THE INTERIOR
HOUSTON SERIES "BLACK LANDS."
REGIONS NOT INCLUDED IN THE SCOPE OF THIS BULLETIN.

FIG. 1.—Map of the southeastern portion of the United States, showing the principal soil provinces of the cotton region. The heavy black line marks the northern and western limits of cotton cultivation.

Appalachian Mountains and plateaus.—This area includes the southern end of the Appalachian Mountains and the Ozark region—all hills and plateaus of considerable altitude but still within the area where cotton is cultivated. The soils are varied, but on account of the cooler climate many of the northern forage plants succeed well.

The black lands or Houston series of soils.—The black-land areas lie principally in northwestern Alabama and northeastern Mississippi and are very similar in character to the extensive "black-wax" soils of Texas. These soils all belong to the Houston series. They possess an abundance of lime and are exceedingly productive but require careful handling. As a rule the natural drainage is poor, and if plowed while wet an artificial hardpan, or plowsole, is soon formed, especially if the land is plowed always to the same depth. When this plowsole is formed, both cotton and grain crops are likely to suffer severely from insufficient drainage in wet weather and from drought in dry weather. By a deep plowing, this hardpan may be broken up, but it is better practice to plow the land at a different depth each season, so as to avoid its formation. To some extent plants with strong taproots, like alfalfa, will penetrate and break up the hardpan.

The Coastal Plains.—The Coastal Plains occupy nearly half the area of the cotton region. The greater part of the area was originally covered with timber, consisting either wholly or predominatingly of pine, for which reason it is often spoken of as the piney-woods region. The soils are of many types, important among which are the Orangeburg, Norfolk, Ruston, and Portsmouth series. In general the surface soil is sandy or sandy loam, which toward the interior is underlain with clay and toward the coast becomes more sandy. In poorly drained areas, called "flatwoods," the soil naturally contains much humus, and this increases through soils of the different series up to the pure peat deposits in the swamps. With suitable crops and proper treatment the sandy soils produce excellent yields. Where the subsoil is clayey the soils are as a rule better, but nearly all are low in lime content.

HAY AND PASTURE GRASSES.

Few of the grasses most grown in the Northern States are useful in the cotton region, as they do not thrive during the long period of warm weather. No one hay grass possesses in the South an importance corresponding to timothy in the North, and it is hardly likely that any such grass will ever be discovered. On this account, success in hay growing requires a knowledge of the relative value and methods of culture of the various grasses that are adapted to southern conditions.

BERMUDA GRASS.[1]

Bermuda grass is the foundation of the best permanent pastures in the South, especially on clayey soils. It endures severe drought and long flooding by water and makes excellent grazing from late spring until heavy frost. On rich and fairly moist clayey soils it grows large enough to be cut for hay, the quality of which is excellent. It is one of the best grasses for creek and river bottom lands, for binding levees and ditch banks, and for lawns which have good care. It is propagated either by seed or by "roots," this term as here used including both the underground stems or rootstocks and the creeping runners.

---

[1] Tracy, S. M. Bermuda grass. U. S. Dept. Agr., Farmers' Bul. 814, 2 fig. 1917.

As the seeds of Bermuda grass are very light and small, the ground should be put in the finest possible condition before they are sown. The sowing should not be done until late in the spring, when the soil has become fairly warm. Immediately after cotton planting is generally the best season for the work. When good seed is used 5 pounds per acre are sufficient. Before sowing, the seed should be mixed with sand or fine soil, to increase the bulk and thus secure a more even distribution over the field. The seeding should always be broadcast and can be done either by hand or by using a wheelbarrow seeder. In any case it is better to sow only half the seed the first time the field is gone over and then the other half, going over the field at right angles to the direction in which the first half was sown, so as to cover skips and balks. If possible, a roller should be used for covering the seeds, but if that is not available a light smoothing harrow or a drag made of brush may be employed. The covering should always be very shallow, and therefore the use of a roller is of great advantage, as it packs and firms the soil without covering the seeds too deeply.

When the seed of Bermuda grass is planted in the spring on well-prepared soil the plants will cover the ground by midsummer and will give a considerable amount of pasturage in the fall, or on the best soils a cutting of hay. It is useless to plant seed on poorly prepared land. Ground seeded in the spring should not be pastured until the sod has become dense, so that it will not be injured by trampling. When bare spots are found they can be filled in by transplanting roots from the thicker places at any time during the summer.

Roots and cuttings are used in propagation much more commonly than seeds. In planting, fresh sods about an inch in thickness should be taken up, either by using a spade or a plow, and then torn into very small pieces for distribution. It is a common practice to plow furrows 4 to 6 feet apart and then drop pieces of sod every 2 or 3 feet and cover with the foot. This method of planting is very inexpensive and answers well where the land is to be used as a pasture, but it leaves the surface of the ground too rough and uneven for a good meadow. If the entire surface is plowed, the pieces may be dropped 2 or 3 feet apart and pushed into the soil with a forked stick, such as is used in setting out sweet-potato vines, and then stepped on, to firm the soil and prevent drying out.

Another method is to plow the old sod very shallow, harrow until the roots are well loosened, rake into piles or windrows, and load into a wagon. The wagon is then driven across the freshly prepared field in which the planting is to be done and the roots dropped about 2 feet apart in the wheel tracks and covered with the foot. The ground should be gone over twice, lapping the spaces, so that the rows will be only half as far apart as the distance between the wheels. An ordinary wagon box will hold enough roots to plant 1 to 2 acres, depending on how finely the roots are divided and how carefully the work is done. Planted in this way, Bermuda grass will cover the ground in a few weeks and the total expense, including the preparation of the ground, need not be more than $5 an acre.

When a field is to be planted for a meadow it should be prepared as carefully as for seeding. Since it is to be a permanent field for mowing and will be used many years for that purpose, all bumps and hollows should be smoothed off, so that the mowing machine and rake may run over it smoothly without being injured by racking and in order that there may be no low spots in which water might stand.

The soil on which Bermuda grass is grown and the treatment which it receives cause great variations in its growth. Plants which when grown on a rich and moist soil make a rank growth, a foot or more in height and with long leaves, when transplanted to a hard clay soil may make a flat and spreading turf with stems only 2 or 3 inches high and with very short leaves. There are, however, a few varieties which are quite distinct from others wherever they may be planted.

The most common variety, which is in almost universal use whereever Bermuda grass is grown, produces stems only about a foot or less in height, though varying greatly. It produces abundant rootstocks, which often run several inches below the surface of the ground, and also makes surface runners, which may be from a few inches to several feet in length.

Giant Bermuda grass,[1] introduced from Brazil a few years ago, is the most rank growing sort yet found. On rich and moist soil it often makes runners 20 feet or more in length and an abundance of ascending stems 2 feet or more in height, affording two or three annual cuttings and yielding more than any other variety yet tested. It has no underground branches and usually produces but few blossoms.

St. Lucie grass is a dwarf variety from Florida, where it is very popular for lawns. It has no rootstocks and is not nearly as resistant to cold as ordinary Bermuda grass.

Many farmers hesitate to plant Bermuda grass for fear that it can not be killed out when the land is wanted for other purposes. It may be thoroughly eradicated, however, when advantage is taken of its peculiarities. It is almost impossible to kill Bermuda grass by cultivation in the summer or by deep plowing at any season. In the northern part of the Bermuda grass region it can be almost or wholly eradicated by a very shallow plowing late in the fall, leaving the furrows on edge as much as possible, so that the roots will be frozen during the winter. Few of the roots will survive a single heavy freeze when turned up and exposed to the air. Farther south, where frosts are less severe, the grass must be killed by smothering. Bermuda grass will bear great heat, drought, and sunshine, but it will not thrive when shaded. When it is desirable to destroy a field of Bermuda grass it should be plowed in September and planted with oats, rye, barley, or some other winter crop. When that crop is harvested the ground should be disked or plowed at once and then planted with cowpeas or velvet beans. When the legume crop is removed, there will be little, if any, Bermuda grass left. This gives two profitable crops during the year and leaves the ground in prime condition for corn or cotton the following season.

---

[1] *Cynodon dactylon* var. *maritimus.*

CARPET GRASS.

Carpet grass is to the light and sandy soils what Bermuda grass is to the heavier and richer soils. It reaches its greatest perfection on the light soils near the Gulf coast, where it comes in very quickly when the land is heavily pastured and trampled; and it is more or less common as far north as central Georgia and northern Louisiana. Its creeping habit of growth enables it to bear close grazing without injury. It is strictly a pasture grass, seldom growing large enough to be worth cutting for hay. It will stand close grazing and heavy trampling better than any other grass in the Gulf region; in fact, considerable trampling seems advantageous to it, as it is smothered out by weeds in time if the land is not kept closely grazed.

The usual method of propagation is to cut some of the grass which has been allowed to mature seed and to scatter the hay over the pasture in which it is wanted. Little seed is produced where the grass is grazed closely, but when animals are taken from a field in July or August an abundant supply of seed can be secured in September or October. The grass grows readily when scattered on the surface of the ground, and comparatively little seed is needed. When even a few patches become established in a pasture it soon spreads over the entire field, and on a field which is well trampled it will make a good sod in about two years, even where the ground has never been plowed. A quicker and surer method of propagation is by transplanting pieces of old sod, as Bermuda grass is propagated, but this is much more laborious and expensive.

Although carpet grass makes little growth after the first heavy frosts in the fall, it furnishes good winter grazing if stock have been removed from the field in July or August, as it will make a growth of 6 to 12 inches by November, and the lower stems and leaves which are protected from frost will remain green and give fresh grazing through the winter; but pastures which have been grazed closely all summer give little winter feed. Like Bermuda grass, it needs sunshine for its best growth, though it makes considerable good feed in wooded pastures and brush land. Good carpet-grass pasture will carry at least as much live stock as good bluegrass pasture.

JOHNSON GRASS.

Johnson grass makes a heavy yield of excellent hay and gives good grazing for one or two seasons, but is such a pest when growing in fields where it is not wanted that its planting in clean fields can not ordinarily be recommended. It makes its best growth on heavy soils, especially on the black prairie lands, clay soils rich in lime, and black-wax lands of Texas. On light sandy soils its growth is weak. On soils suited to its growth it yields very heavily for two or three years, after which the thick, heavy rootstocks become so matted that the yield is greatly reduced. If such land is to be kept as a meadow it should be plowed and harrowed about once in three years, after which it will yield as heavily as ever. The hay made from Johnson grass is of excellent quality if cut before the seeds are formed, but as the plants mature they become tough and fibrous. The grass does not bear grazing well, as the rootstocks are weakened and the growth of stems and leaves becomes very small.

Grazing does not kill the grass, however, for when an old pasture which was originally well set with it is plowed up the grass soon becomes vigorous again. It is quite possible to eradicate it without excessive labor or expense. When there is only an occasional small patch in the field it can be killed by hoeing thoroughly and then covering the surface of the ground with half an inch of common salt. When a large area of Johnson grass is to be destroyed it can be done by taking advantage of the fact that the rootstocks from which the new shoots are produced live only one year and that they are formed near the surface of ground which has not been plowed recently, especially if it has been heavily pastured. If the land is not plowed for a year the young rootstocks will all be found within 2 or 3 inches of the surface. By plowing shallow late in the fall when the weather is dry and following that by a thorough harrowing with a spring-tooth harrow which will drag the roots out of the ground, nearly all will be killed during the winter. This should be repeated in the spring and the ground planted in some hoed crop, like cotton or corn, and the few sprouts which may appear should be destroyed. The only expense is for the extra plowing and harrowing, and that is more than repaid by the additional crop which will be made as a result of the thorough working of the ground.[1]

---

[1] Cates, J. S., and Spillman, W. J. A method of eradicating Johnson grass. U. S. Dept. Agr., Farmers' Bul. 279, 16 p., 8 fig. 1907.

SUDAN GRASS.[1]

Sudan grass is very similar to Johnson grass in appearance but is strictly annual in its growth, does not reseed the ground on which it is grown, and so can be used in rotation with other crops. It is grown principally as a hay and soiling crop, though it gives abundant and excellent grazing until destroyed by trampling or killed by frost. It will grow on almost any soil which is not too wet, and it bears drought with little injury.

Sudan grass is sometimes sown broadcast, but does best when planted in drills and given one cultivation early in the season and another after each cutting. It is also better to plant it in drills when the crop is to be grazed, as the grazing animals usually walk between the rows and so do not trample the plants. The drills should not be more than 12 to 18 inches apart. In sections suited to its growth Sudan grass yields from two to four cuttings of 1 to 2 tons each, and the hay is of excellent quality.

Though it bears severe drought without injury it is greatly weakened and injured by excessive rains and so is not well suited to cultivation in Florida and along the immediate Gulf coast westward to Texas, but in the central and northern portions of the cotton region and in the dry climate of Texas and westward Sudan grass is one of the most valuable and productive grasses of recent introduction.

DALLIS GRASS.

Dallis grass[2] is known also as golden-crown grass, paspalum, large water grass, and smooth paspalum. It came originally from Argentina and has become thoroughly established in all the cotton region where the soil is fairly heavy and somewhat moist. It does not thrive well on very dry or very sandy soils, but is most abundant on the creek bottoms and low lands from South Carolina westward to Louisiana. It is a perennial which makes a continuous growth during warm weather, is not injured by close grazing or by moderate frosts, and so has great value as a pasture plant for both summer and winter. When the plants are scattering it is inclined to grow in rather large clumps and therefore is better for grazing, but when it occupies the ground fully the clumps are small and the growth nearly erect. The grass seems to make its best growth in central and northern Georgia, Alabama, and Mississippi and is sometimes cut for hay. The land on which it is grown may be mowed twice during a season, the first cutting in May being largely of vetches and mixed grasses, and a second and better cutting in midsummer, when the yield may be as much as 2 tons per acre. The hay is of excellent quality and sells readily on the local market.

---

[1] Vinall, H. N. Sudan grass as a forage crop. U. S. Dept. Agr., Farmers' Bul. 605, 20 p., 10 fig. 1914.

[2] *Paspalum dilatatum.*

Dallis grass is rather difficult to propagate, as it does not spread by runners, and a large part of the seeds fail to mature in good condition. The best seeds are usually those which ripen late in the season, and during October and November a limited supply may be obtained from the scattering plants which are found on nearly every farm. Those who cut the grass for hay often secure seed from the refuse in the bottom of the mow, though much of the seed collected in this way fails to grow. Fortunately, the grass is very hardy, and when a few plants have become established in a field it will spread slowly over the richer part of the ground. It never becomes a weed and is rarely seen on cultivated ground. American seed is not often found on the market, and much which is sold as Dallis grass is seed of purple water grass, or purple paspalum, an annual and almost worthless species. Australian seed is expensive and not high in germination. This grass is one of the best for winter grazing in the South, and it is well worth while to establish it on every farm south of Tennessee and North Carolina. The seed may be sown broadcast at any time during the late fall or winter, after which the ground should be disked or harrowed, though a fair stand is often obtained by scattering the seed over the field and giving it no further attention.

VASEY GRASS.

Vasey grass,[1] sometimes called bull-grass, is very similar to Dallis grass, but is taller, strictly erect, and less leafy. It was long since accidently introduced from Argentina and has now become quite common in all the southern part of the cotton region, being most abundant in southern Louisiana and Mississippi and in some parts of Florida. It does best on low ground which is usually moist and often makes a heavy growth on ground which needs to be drained to produce a thrifty growth of most other crops. It is more valuable for hay than for grazing, as it does not bear frost as well as Dallis grass. It makes a heavy yield of hay, which is of very good quality and finds a ready sale in the New Orleans market.

Vasey grass is propagated by seeds only, and as there are no seeds now on the market the only way to provide for its increase is to gather seed by hand in old fields where it is now growing and sow in the fall on the fields where it is wanted. It spreads well by self-sown seeds, and when it has once become well established in the upper part of a creek bottom it soon spreads to the lower parts. It never becomes a troublesome weed, being easily eradicated by a single plowing.

PARA GRASS.

Para grass, which is probably native to South America, is now common in most of Florida and to a considerable extent farther west, especially in southern Texas. It is best adapted to Florida and the Gulf coast, though it survives the winters as far north as Charleston, S. C. It is a rank-growing perennial, spreading by runners, often 30 or more feet in length, which form roots at each joint that touches the ground. As soon as the ground becomes fairly well covered with these runners, erect or ascending branches are produced, reaching a height of 2 to 4 feet or more and making a heavy yield for either hay or grazing. Although Para grass spreads so rapidly by its long runners, it is more easily killed than Bermuda grass or Johnson grass, as the runners are wholly above the surface of the ground and can be destroyed by a single shallow plowing late in the fall followed by a thorough harrowing. In regions where heavy frosts occur plowing will kill it if the work is done at the beginning of the cold weather. Though it makes a fair growth on moderately dry soil it does much better where the ground is wet and on the margins of ponds often reaches to where the water is 3 or 4 feet deep. It is a desirable species for planting on lands liable to overflows, as it is scarcely injured when covered by water for a month or more.

---

[1] *Paspalum larranyagai* or *P. vaseyanum.*

Para grass produces little good seed and is usually propagated by divisions of the runners. These root readily if cut into pieces of two or three joints each and pushed into freshly plowed ground so as to leave the upper joint just at or a little below the surface. When sets are abundant it is better to put them about 2 feet apart. Planting may be done at any time from early spring until about three months before frost is expected. This grass makes a rather coarse hay, but is sweet, tender, and nutritious, and the yield is very heavy. One Texas grower reports 4 tons per acre from each of two cuttings on a 12-acre irrigated field and that a third crop, equally heavy, was grown but was not cut on account of an early frost. Florida growers make three to four cuttings annually, and the hay finds a ready market at a good price. Para grass is also excellent for pastures when not grazed too closely. One field of 10 acres in southern Texas gave grazing for 15 cows from May to November, and at the close of the season the grass was fully 2 feet tall and appeared to be growing faster than it was eaten, though the field had not been irrigated during the preceding 18 months. A grower in southern Mississippi reports equally good results from a planting made on low rich land and very poor results when planted on dry clay. A field which is well set with the grass may be kept in good condition almost indefinitely if it is given a shallow plowing in the spring and then seeded with cowpeas. The grass will make a vigorous growth and the first cutting will be ready when the peas begin to mature, the mixture making a hay of choice quality and a better yield than when the grass is grown alone. The pea vines will make no further growth, but the grass will yield two to four later cuttings, each heavier than if the ground had not been plowed.

Some of the Florida orange growers who have it thoroughly established in their groves complain that Para grass makes cultivation difficult and that it is seldom advisable to allow it to gain a foothold on land which is to be cultivated. In Cuba and in the extreme southern part of Florida, where the rainfall is heavy and frosts are rare, it may be a dangerous weed, but it is easily killed wherever moderate frosts occur and in irrigated regions by withholding the water a short time. It is killed to the ground by heavy frosts and is not recommended for planting where the temperature falls below about 18° F.

CARIB GRASS.

Carib grass[1] is very much like Para grass in appearance and manner of growth, though the runners are not as long and it makes a better, nearly erect growth. It needs the same soil and treatment and is propagated in the same way. Though it apparently produces seed abundantly, the seeds are usually defective and will seldom germinate. Carib grass seems to be slightly less resistant to cold than Para grass and so can be grown hardly so far north. Where both can be grown it makes a heavier yield and a finer hay than Para grass. It makes heavy yields in central and southern Florida, in southern Louisiana, and in the irrigated region along the Rio Grande in southern Texas.

GUINEA GRASS.

Guinea grass, a native of Africa, is now a common grazing grass in Cuba and other West Indian islands, whence it was introduced into Florida as early as 1870. Though very different in appearance and habit of growth, it has often been confused with Johnson grass, which has been called by the same name. Johnson grass spreads by long fleshy underground branches and has large seeds, which are red, yellow, or nearly black, and Guinea grass grows in dense, erect clumps, does not spread by rootstocks, and has small seeds which are dark green. The leaves of Guinea grass are never streaked with red or yellow, as those of Johnson grass often are. Anyone who notes any of these characters will never mistake one grass for the other.

Guinea grass grows to a height of 6 to 12 feet and is useful principally for soiling. Its range of profitable cultivation is about the same as that for Para grass, including the whole of Florida and a narrow strip westward along the coast south of latitude 31°. It has been grown successfully near Mobile for some years and matures an abundance of seed both there and in southern Mississippi. It is very promising in the few localities where it has been tried in southern Texas. It does well on moderately dry soil and can never become a pest like Johnson grass. It is propagated by divisions of the roots or by seeds. When roots are used the old clumps should be dug out early in March and divided, a single stem with a few good roots being sufficient for a set. If planted about 3 feet apart in rows 6 feet wide the young plants will give a good cutting in May. Seeds are planted at the same season as the roots, the usual practice being to plant them in drills and then to transplant the seedlings when they are 3 or 4 inches high. Volunteer seedlings are usually found in abundance where the old plants have been allowed to mature seed. Sets are more expensive and troublesome than seedlings, but will give an earlier and heavier yield the first season.

---

[1] *Eriochloa subglabra.*

When the crop is to be used for soiling and heavy yields are expected the ground should be occasionally cultivated and a dressing of cottonseed meal given just before each cultivation. The grass begins its growth rather late in the spring, seldom giving much feed before May, but after that time it will give good cuttings once every three or four weeks until its growth is stopped by frost. In the most favorable part of the season cuttings may be made every 10 or 12 days, though such a rapid growth is maintained for only a few weeks. The grass makes the best feed if cut when 18 to 24 inches high. If allowed to stand too long the stems become hard. It is difficult even to estimate the yield per acre, as the grass is used principally for soiling, its habit of growing in large clumps making it difficult to cut for hay. One grower, who has used it many years for soiling, reports that he can feed four head of cattle per acre through the entire season, while another, who is raising cattle extensively, reports that he grazes three head per acre through the entire year, but adds that he also gives a little Para grass hay in the winter. It does not bear frost well and is often killed by a temperature of 25° F.

RHODES GRASS.[1]

Rhodes grass is a perennial with very leafy, slender, erect stems, 3 to 5 feet tall, and very long and narrow leaves. It seeds freely at the tops of the stems in clusters of 10 to 20 spikes, 3 to 4 inches long. In addition to the erect seed-bearing stems, it produces numerous prostrate runners, which are often 6 to 8 feet in length and take root at every joint where they rest on the ground, so that even where the original stand is thin these runners soon cover vacant spaces of considerable size. They serve not only to spread the grass, but also to establish a constant succession of new plants, more vigorous and productive than those which are older. Although the grass seeds freely and also spreads by runners it is easily controlled and rarely becomes troublesome as a weed.

---

[1] Tracy, S. M. Rhodes grass. U. S. Dept. Agr., Farmers' Bul. 1048, 16 p., 3 fig. 1919.

Owing to its inability to withstand severe cold, Rhodes grass is not grown north of Florida, the immediate Gulf coast, and southern Texas. In Florida it is grown principally from St. Augustine southward along the east coast, from Brooksville southward along the west coast, and in a good part of the Everglades region. Probably more than half the total acreage in this country at the present time is in Texas, from Houston and San Antonio southward to the Rio Grande, and there it has become the practice to have one or more acres of it for a feed and pasture lot near the stable on every farm and ranch. It rarely survives the winter where the temperature falls below 15° or 18° F., and on that account it is sometimes grown as an annual in regions of colder winters, as it will then give two or three cuttings of about 1 ton each during the summer and fall; but at the present price of seed that is seldom profitable.

Rhodes grass does best on a soil which is fairly moist, although it will live and make some growth during several months of drought. A deep, rich loam is best suited to it, and it is likely to be unsatisfactory on dry, hard clay or on dry sandy soils. It grows vigorously on the well-drained peaty soils of Florida, on the reclaimed muck soils of southern Louisiana, on the heavy irrigated lands of southern Texas, and on the black-wax soils wherever there is a moderate amount of rainfall or where irrigation is available.

Early in the spring, when the soil is in a proper condition and there is no further danger from late frosts, or in late summer the ground should be well plowed and then harrowed until the surface is fine and even. Too much stress can not be put on the importance of thorough preparation. As the seed is often low in germination and the young plants are weak until they become well rooted, it is poor economy to risk the securing of a full stand by withholding a little work in preparing the field. The most successful growers in Texas recommend that the ground be prepared by irrigating, plowing, double disking, harrowing, seeding, rolling, and then another irrigation. Florida growers, who are not obliged to irrigate, recommend plowing, harrowing, smoothing with a plank drag, seeding, and then rolling the heavier soils or using a weighted plank drag on those which are more sandy. The important point in seeding anywhere is to have the soil sufficiently moist to germinate the seed quickly and then to maintain this moisture until the young plants become well established.

The quantity of seed needed varies with its quality and with the condition of the land. When the land is in good condition and well-cleaned seed is used, from 7 to 8 pounds per acre are sufficient, and some planters use much less. From 2 to 3 pounds are sufficient where a press drill is used on well-prepared soil.

The seed is usually sown broadcast, the work being done on a still day, so that the wind will not interfere with an even distribution.

After the seed is sown it should be covered very lightly. In regions of abundant rainfall a light harrowing or covering with a plank drag is usually sufficient, although if that is followed by a rolling it will be better. In Texas and other dry regions the use of the roller is much more important, as it is necessary to compact the surface of the soil so as to conserve all the moisture possible. If the soil is not fairly moist when the seed is sown, it should be irrigated immediately. The seeds germinate rather slowly, and as young plants are weak they should not be allowed to suffer from lack of moisture before they have become well established.

Under favorable conditions the crop is often grazed within a month after seeding, and frequently it will give a fair cutting for hay in two months, though the first cutting is likely to be somewhat weedy.

The yield of Rhodes grass hay varies greatly with the character of the soil and the length of the growing season, and still more with the amount of moisture in the soil. Cuttings should be made as soon as the seeds begin to ripen, and in arid regions each cutting should be followed immediately by an irrigation, so as to secure a new growth as quickly as possible. Little new growth is made after cutting until the soil is well moistened. From three to six cuttings usually can be made during a year, about five weeks being sufficient for the growth of a hay crop when all conditions are favorable. When Rhodes grass is grown on thin sandy or clay soil with only a moderate amount of rainfall or with insufficient irrigation, the yield may be only 1 or 2 tons per acre, while on the soils best suited to its growth and well supplied with moisture the yields are often 8 tons or more.

The quality of hay made from Rhodes grass is superior to that of hay made from most other grasses, in that it contains a larger proportion of leaves, while the stems are slender, tender, and sweet, so that the hay is eaten with very little waste. Horses, mules, and cattle eat it with great relish. It retains its color well in drying, therefore making an attractive-looking bale for the market.

Rhodes grass was first cultivated on account of its value for pasture. In regions where this grass can be grown, the grazing season lasts through the entire year, though, of course, the quantity of feed produced is much less in cool weather than during the summer.

NATAL GRASS.[1]

Natal grass, from South Africa, resembles crab-grass in its manner of growth, but produces a better quality of hay and on soils which are very sandy a much heavier yield. It is an annual, but reseeds the ground so freely that its growth is practically continuous on suitable land where it has once been grown and which has been given the proper cultivation.

---

[1] Tracy, S. M. Natal grass: A southern perennial hay crop. U. S. Dept. Agr., Farmers' Bul. 726, 16 p., 4 fig. 1916.

When a single plant of Natal grass is allowed abundant room it will form a large tuft, sometimes 3 to 4 feet in diameter. The lower branches soon become decumbent, while the central stems are more nearly erect. When planted closely, however, the tufts are much smaller, often making only a few stems and those nearly erect. The stems are slender, 2 to 4 feet high, and well covered with leaves, which are so nearly erect that few are lost in mowing the hay.

Natal grass makes its principal growth in middle and late summer and is usually grown in rotation with some winter or early-spring crop. It is one of the best grasses for soils which are very sandy and dry, as on such soils it reseeds the ground for succeeding crops, which it does not do when grown on heavy or wet soils, where other grasses, such as Para, Carib, or Bermuda grass, are usually more profitable.

Natal grass is grown more largely in central and southern Florida than elsewhere and is commonly used as a catch crop to follow winter crops of vegetables and as a cover crop in citrus groves. It will give two or three cuttings of three-fourths to 1 ton each during a season and makes a hay of desirable quality.

CRAB-GRASS.

Crab-grass is of considerable importance as a volunteer hay crop, especially on sandy soils. It makes its growth late in the season on lands from which early crops, such as oats, melons, or potatoes, have been taken and often makes a good growth in fields of cowpeas, where it adds largely to the yield of hay. The crop should be cut early, soon after the first seeds begin to mature. It is somewhat difficult to cure, but when well handled at the proper stage of growth it makes a hay of good quality. It is always a volunteer crop and need never be sown.

KIKUYU GRASS.

Kikuyu grass,[1] recently introduced from Uganda, Africa, has leaves and creeping stems much like those of carpet grass, though much larger and more succulent. It makes a very dense growth, the first growth being erect, but when the stems reach 15 or more inches in height they become very decumbent at the base, matting down so that the lower leaves soon die; hence the grass is not well suited for making hay. It bears frost about as well as carpet grass, is much more vigorous and productive, is eaten greedily by horses, cattle, and hogs, and promises to be of great value as a pasture grass. It has been planted in many places in Florida and westward to Texas, and most reports of its growth have been favorable.

---

[1] *Pennisetum longistylum.*

As kikuyu grass does not make seed in this country it must be propagated vegetatively, like Bermuda grass. The cuttings should be planted in spring on good soil which is not too dry, setting them 2 to 3 feet apart, so that the ground will be covered quickly. After it becomes established the grass should be grazed so close that no stems will be long enough to fall down and smother the new growth.

While the introduction of this grass is too recent for its true value for pastures to be fully demonstrated, it has done so well wherever tested that it is well worth extensive trials.

MAIDEN CANE, OR PAILLE FINNE.[1]

The grass known as "maiden cane" in Florida and along the South Atlantic coast and as "paille finne" or "pifine" in Louisiana is a species which is native to those regions, but is rarely seen elsewhere. In Florida it is very abundant in the Everglades region and northwestward to Tallahassee, and it is also abundant on the low mucky soils of the Atlantic coast as far north as Charleston, S. C. In Louisiana its growth is confined almost entirely to the region west of the Mississippi River and south of the Southern Pacific Railroad, where it is most abundant on lands only 2 or 3 feet above the ordinary water level in the neighboring bayous and canals. It is rare on salt marshes or on timbered lands.

If cut when the growth is young, maiden cane makes a hay of remarkably high feeding quality, but if allowed to stand until the stems become woody it has little value. Probably a third of the land on which it is growing is sufficiently high and dry so the grass can be cut with a mowing machine and handled like ordinary hay, but a great part of the natural meadows are too low and wet for the use of machinery, so the mowing must be done by hand and the hauling by drags, which make the hay expensive. Nearly all of the land on which the grass is growing, however, is so high that it can be drained easily and so be made available for permanent meadows, which will give from three to five annual cuttings, averaging fully a ton each. Lands which have been cut over annually for several years show no decrease in yield, so the grass seems to be practically permanent.

Planters who have used maiden cane are almost unanimous in regard to its high value for grazing. In southern Louisiana it is extremely profitable to buy feeders from northern Louisiana, the New Orleans stock yard, or other places, put them on the paille finne pastures for feeding and fattening, and then market them within six months without having given them a pound of any grain feed, the pasture alone being sufficient to put the animals in good marketable condition. In many such cases the net profits have been from 50 to 100 per cent.

---

[1] Tracy, S. M. Paille finne grass. La. Agr. Exp. Sta. Bul. 147, 7 p. 1914.

As the grass rarely produces seed it can be propagated only by planting the slender rootstocks, which are produced very freely. That method, however, is so slow and expensive that it will seldom be profitable, though the grass is one which has great value where it grows naturally.

ORCHARD GRASS.

Orchard grass seldom makes a heavy yield of hay in the cotton region, but it is an excellent pasture grass on wet and heavy soils in the northern part. It is a perennial which begins its growth very early in spring, and it furnishes good grazing until checked by the summer drought. With the first autumn rains it starts a new growth of leaves, making rich fall pasturage and remaining fresh and green through the winter if the cold is not too severe. Hay made from it is of excellent quality, though its habit of growing in large clumps is against its use as a hay grass. It bears grazing well and recovers quickly when cropped down. It does well when mixed with redtop and succeeds better than almost any other grass in woodland pastures. Sandy soils are not suited to its growth, and it can not be recommended for any light or thin lands.

RYE-GRASSES.

Two species of rye-grass, Italian and perennial,[1] are commonly cultivated. The former, while not truly an annual, is agriculturally treated as such. It makes a more rapid and usually a larger growth than the latter. Both are quckly injured by excessive heat or drought and so are not suited for permanent meadows or pastures, but as they make a quick and vigorous growth soon after planting they are valuable where immediate results are wanted. They are especially desirable for sowing with redtop and other slow-starting grasses. If sown in the fall they will give rich late winter and spring grazing, or they may be cut for hay in April or May, after which they soon disappear. It is important that the crop be cut as soon as well grown. If that is not done the warm rains of June and July will cause the leaves to decay very rapidly and smother the small plants of other grasses which may be growing on the same ground. On rich alluvial land these grasses often persist two or three years when used for hay, but seldom last more than one year when grazed. They are among the best of grasses for planting on newly made lawns, as they soon cover the ground and give it an attractive appearance while the Bermuda grass and other slower starting sorts are becoming established. Seed should be sown in October or February, at the rate of 20 to 30 pounds per acre when sown alone or half that quantity when sown with other grasses. Italian rye-grass is becoming more and more used for fall planting on the sandy coast lands. It makes a much better pasture or hay than rye.

---

[1] *Lolium multiflorum* and *L. perenne.*

REDTOP, OR HERD'S-GRASS.

While redtop is seldom used alone for either hay or grazing it is an important factor in both meadows and pastures. It is slender in growth, and the yield is not large, though the hay is of good quality. It makes its best growth on soils too poorly drained for most other crops and therefore is important on all wet lands. Redtop is a perennial which bears frost well and so gives winter grazing. It does better on wet clay soils than on those which are sandy and has little value for dry uplands. It is one of the best kinds for creek banks, the margins of swamps, overflowed lands, and similar places where Bermuda grass, bluegrass, and other upland kinds can not be grown. On the rice lands of South Carolina it succeeds better than any other tame grass. Seed may be sown in either fall or spring at the rate of 6 to 10 pounds of recleaned seed per acre. The growth is usually weak the first year, but it gains vigor with age and holds the ground well against other grasses.

KENTUCKY BLUEGRASS.

The northern limit of the cotton region is nearly the same as the southern limit of the bluegrass country, though Kentucky bluegrass does well in some places from North Carolina westward to Arkansas, especially in the valleys of the limestone country. It is seldom used for hay, as its growth is too short and the yield too light, but where it can be grown it makes excellent pastures. It succeeds best on a rich lime soil which is clayey rather than sandy and is well drained without being too dry. It makes its best growth in fall and spring and remains green through the winter, but suffers severely in long-continued hot weather, and so is not suited for use in the extreme South.

RESCUE GRASS, SCHRADER'S GRASS, OR AUSTRALIAN OATS.

Rescue grass, Schrader's grass, or Australian oats, is sometimes highly valuable and at other times disappointing. When planted on a very rich loamy soil and the season is favorable it makes a heavy winter growth, which affords fine grazing from December to April or a heavy yield of hay in early spring and often a second cutting later. If the conditions are not favorable it may not begin its growth until late winter, only a poor stand will usually be secured, and its growth will be weak and unsatisfactory. It disappears on the approach of hot weather, but a few of the plants will live through the summer and with the scattered seed will often make a good volunteer growth the following season. Its growth and behavior are so uncertain that it is a reliable hay plant in only a few localities, but its winter growth makes it a desirable addition to pastures, especially for mixing with orchard grass, bur clover, and vetches.

TIMOTHY.

Timothy has little value in the cotton region except in the extreme northern section, as it makes almost no second growth after being cut, the corms at the base of the stem being injured or killed by exposure to the hot sun through the long summer. If sown in the fall or in early spring it will give one profitable cutting and then almost wholly disappear. A few alfalfa growers practice sowing timothy with the alfalfa seed in September, as it does much to occupy the ground and prevent the growth of crab-grass until the alfalfa is strong enough to protect itself, besides giving one good cutting for hay in early spring. Italian rye-grass is, however, preferable for this purpose. Timothy can not be recommended for general cultivation in any part of the cotton region.

MILLETS.[1]

The millets which are of greatest value in the cotton belt are those belonging to the foxtail group, of which there are several well-marked varieties, differing mainly in size of plant and length of season required for their growth. Common millet is the smallest and hardiest form, ripening earlier and growing on poorer soils than either of the others, and making a finer and better hay, though even when grown on rich soils its yield is not as heavy as that of German millet. It requires 45 to 50 days from seeding to cutting and is probably the best variety for growing on soils which are thin and dry.

Hungarian millet when grown on good soil yields more heavily than the Common, though it does not bear drought as well. It requires 50 to 60 days from seeding to cutting.

German millet is larger and coarser than either of the other varieties and requires a richer soil, with an abundant supply of moisture. It is much the largest of the three foxtail millets, has a rather coarse stem with very large and usually drooping heads, and produces a large amount of seed. The hay is so coarse that it is less valuable than that from the others, but the crop is excellent for feeding while green, and its yield is so heavy that it is of special value for soiling. By making sowings at intervals of two to three weeks from May to July it is easily possible to have a good succession of soiling crops from July until September, just at the time when such crops are most needed. German millet requires 60 to 75 days from seeding to cutting. This is nearly or quite the same as is the variety known as Golden millet.

---

[1] Vinall, H. N. Foxtail millet: Its culture and utilization in the United States. U. S. Dept. Agr., Farmers' Bul. 793, 28 p., 10 fig. 1917.

All of these millets require warm weather for their growth, and as all of them are very shallow rooting the surface of the soil should be made very fine and smooth before the seed is sown. From 2 to 3 pecks of seed per acre should be used and may be sown either with a drill or broadcast. The sowing should be followed by rolling if the ground is very dry.

The cutting for hay should be made as soon as one-fourth to one-half of the heads of the millet are out of the "boots." If allowed to stand until fully headed the stems become hard and unpalatable and are less digestible, the beards become so harsh that they sometimes cause irritation in the stomach, and the hay is much less valuable than when cut earlier. When cut at the proper time the hay is of excellent quality, though it should be used with some other feed when given to horses and mules, as when fed alone, especially if overripe, it sometimes causes increased action of the kidneys, lameness, and swelling of the joints. When cut at the proper time millet may be used with safety for at least half the feed for horses and mules and may be fed without limit to cattle.

It sometimes happens that, owing to unfavorable weather or a press of other work, it is impossible to cut millet in the right condition for making good hay. In such cases it is better to let the crop stand until the larger part of the heads are mature and then harvest it for seed, cutting, binding, and thrashing it like wheat or oats. The seed is always in demand at a good price, and the stems are so broken and torn after thrashing that they make a feed of fair quality for cattle.

There are few other crops from which as much hay of equally good quality can be made in so short a time. Some growers object to the crop because it is hard on the land, but there is little foundation for that claim. The crop is usually cut during the hot and dry weather of August and September, and when any soil is suddenly left bare at that season the ground is sure to bake and become hard very quickly. If the ground is wanted for immediate use it should be plowed within a day or two after the millet is taken off, as it will be very hard to work a few days later. If, however, it is not needed for some time it should be let alone, and after the fall rains have softened the surface it will plow as easily and be as mellow as ground on which any other summer crop has been grown.

Millet is not recommended for the principal crop of hay, for it is not as good as some others, but it is one of the best for use in an emergency when a hay crop must be made during two or three months in summer when the ground would otherwise be idle, and it is also one of the best that can be grown for green feeding during the dry weeks of the late summer.

COLORADO GRASS, OR TEXAS MILLET.

Colorado grass, or Texas millet,[1] is valued highly for a late hay crop on the river-bottom lands of southern Louisiana and Texas, where it is native. It is an annual, growing from 2 to 4 feet tall, very leafy, and valuable for both hay and grazing. It prefers rich alluvial soils, where it volunteers, like crab-grass, but it does not grow well on dry uplands. Like crab-grass, it should be cut early before the seeds have matured, when it makes excellent hay. If left until fully ripe the stems become hard and a large part of the seed is lost. It has not succeeded well on the Atlantic coast or in the northern parts of the cotton region, but seems especially adapted to the river-bottom lands of southern Louisiana and Texas. The seed may be sown at any time during the early summer at the rate of 40 pounds per acre, and when one crop has been grown the land will not need reseeding the following year.

CEREAL GRASSES.

Wheat, oats, rye, barley, and to some extent rice are used both for winter pastures and for hay. All except rice are usually sown in the fall, as they then give good grazing through the latter part of the winter. If the animals are taken off just before the stems begin to shoot, a fair crop of hay can be made by cutting the wheat when it is in the milk stage and the oats when a little riper. Spring-sown oats also make fine hay, but usually do not yield as well as those sown in the fall. If wanted especially for grazing, the varieties known as Myers Turf and Gray Virginia are excellent, while the Texas Rust-proof is more popular for hay. Rye and barley make poor hay, but are excellent for winter and spring grazing. For most winter grain crops about 1½ bushels of seed are used per acre; for oats the quantity of seed is usually a fourth or a half greater. Good hay is made in many places from the rice fields which have been cut for the grain. Such fields usually make a considerable second growth of rice and may even head well, but seldom mature good seed. The land on which such hay is made must not be flooded while the second growth is coming on, or the leaves will become covered with sand and mud and make the hay dangerous for feeding.

COARSE FODDER GRASSES.

Several important southern forage crops are closely comparable with corn in habit, and as a consequence the methods of culture are similar. Like corn they may all be used for pasture, soiling, silage, or dry fodder. These plants are sorghum, teosinte, Japanese sugar cane, and Napier grass. The first two are annual, the others perennial.

---

[1] *Panicum texanum.*

SORGHUM.[1]

Sorghum is extensively grown in the cotton region for soiling, silage, and hay. The varieties are numerous, but the principal ones used in the South are the sweet sorghums, especially Orange, Amber, Red Amber, Sumac, Honey, and Gooseneck. The grain sorghums are not so desirable, as all or most of the seeds are destroyed by the sorghum midge. The crop is remarkable for its ability to withstand severe periods of drought and therefore is extensively grown in semiarid regions.

Sorghum should be planted as soon after corn as the ground is thoroughly warm. Where the season is long it may be sown from this date to as late as will permit the crop to mature safely, but if two cuttings are desired a comparatively early seeding is necessary. Sorghum may be sown either in a furrow with a lister or in the surface soil with an ordinary corn planter. Sumac sorghum can be sown either in rows the same distance apart as Indian corn (36 to 44 inches), sown broadcast, or drilled in with a grain seeder. Sowing in rows is usually advisable, as it gives a larger yield. If seeded in cultivated rows, 4 to 6 pounds of seed to the acre will be found ample. If sown broadcast or with a grain drill, 1 to 1½ bushels of seed per acre usually give the best results except in the very dry sections, where 2 to 3 pecks are better. Broadcast seedings should be thick enough to keep the stalks fine.

The crop should be harvested for forage purposes when in the late milk stage. Where a seed crop is desired, cutting can be delayed until the seed is in the late dough stage without materially decreasing the feeding value of the fodder. To some extent the time of cutting can be regulated by weather conditions. When grown in cultivated rows it is most efficiently and economically harvested with a corn binder and put in shocks of 20 to 30 bundles each. The corn harvester is also serviceable if the crop is to be used for silage. If sown broadcast or in close drills it is often cut with a mower and cured like other hay crops. This method is undesirable, because the sorghum is hard to cure and difficult to handle with a fork. A better method is to cut it with an ordinary wheat binder and allow the bundles to cure in shocks.

Sorghum cut with a corn harvester can be stored in the barn after it is thoroughly cured, or it can be stacked in the open. Sorghum in bundles or as loose hay turns the water well, so that there is small loss from spoiling in the stack.

---

[1] Warburton, C. W. The nonsaccharine sorghums. U. S. Dept. Agr., Farmers' Bul. 288, 28 p., 9 fig. 1907.

Properly cured sorghum hay is excellent on account of its leafy character. All live stock eat it greedily, the large amount of sugar in the stems making it quite palatable. For silage purposes it is practically equal to corn. If cut for silage when the seed is nearly hard, no trouble from spoiling will be experienced.

Sorghum fodder or hay is an excellent roughage and in many localities is practically the only kind used. For milk cows and work horses 12 to 18 pounds a day, if supplemented by the ordinary quantity of grain, are sufficient. Sorghum roughage will be much more effective in fat production if, in connection with it, a small amount of some concentrate high in fat, like cottonseed meal, is given the animal. Cattle and horses are often carried through the winter without the use of grain by feeding them liberally with sorghum fodder.

Sorghum is often pastured, especially to hogs. Cattle are sometimes poisoned when pastured on second-growth sorghum late in the fall, but cases of this kind have been much less frequent in the South than in the North.

TEOSINTE.

Teosinte is similar in habit to corn and requires a long season of warm weather, a rich soil, and abundant moisture in order to succeed well. It is useless to plant teosinte where all these conditions can not be had. It is a remarkably vigorous grower, reaching 10 or 12 feet in height, with an unusually abundant supply of leaves and slender stems which continue to grow until killed by frost. It is planted and cultivated like corn, and if cut when it reaches 4 to 5 feet in height makes excellent fodder and will produce a second cutting fully as large as the first. If left to grow until September or October it furnishes excellent material for the silo in greater quantity per acre than either corn or sweet sorghum. It is also one of the best plants for soiling purposes. The plants stool freely, sometimes as many as 50 stalks growing from a single seed; its leaves are similar to those of sweet sorghum, but much longer, and the stalks contain 8 to 10 per cent of sugar. Its growth is very rank, the Louisiana Agricultural Experiment Station reporting a yield of more than 50 tons of green feed per acre on rich alluvial soil. Its season of growth is so long that it seldom matures seed north of latitude 30° N., but it has ripened well at the Florida and Louisiana experiment stations. The seed, 4 to 5 pounds per acre, should be placed in hills 4 to 5 feet apart each way at about the time cotton is planted. The greater distance should be given on the richer soils. On lands of only moderate fertility sweet sorghum is much to be preferred.

JAPANESE SUGAR CANE.

Japanese sugar cane is similar in habit of growth to the ordinary sugar cane of Louisiana, but the stalks are more slender and the stools larger; it also stands more frost and needs replanting less frequently. It is propagated by planting sections of the matured canes in the same manner that the Louisiana sugar cane is propagated, and its cultivation is practically the same as that needed for corn. It may be planted in either fall or spring, fall planting being preferable, as that gives it an earlier and better start in the spring. It is planted in rows about 6 feet apart, the rows being opened by running two furrows to throw out the earth and to make a shallow trench in which the canes are laid lengthwise and covered

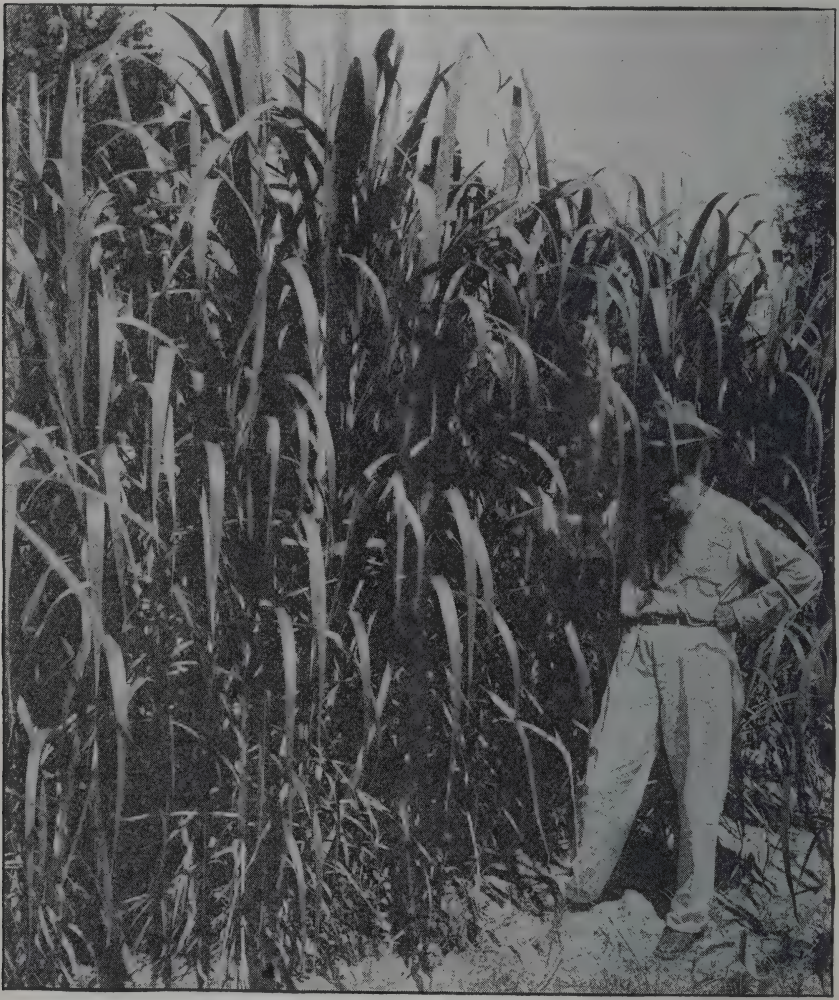


FIG. 2.—Japanese sugar cane, full grown, in Mississippi.

by throwing the furrows back. When an abundance of canes can be had for planting it is better to lay two canes side by side the entire length of the row, breaking joints, and so securing an even and perfect stand. When canes are scarce only a single line need be used. In some cases, if the canes are very large and the ground in fine condition, good success is obtained by cutting the canes into pieces of three or four joints each and planting them 2 feet apart.

On fairly rich soil Japanese sugar cane continues to make good yields for many years, though the soil must be frequently and heavily fertilized for continuous high yields. On good soils it makes 40 to 60 tons of green feed per acre, and many growers prefer it to sorghum for cows and hogs. The leaves are killed by moderate frosts, but the stalks remain sweet unless actually frozen and can be kept in good condition through the winter by windrowing. When canes are windrowed for keeping them through the winter they are cut, and those from four rows are laid lengthwise in the central space and covered with sufficient soil to protect them from freezing. Care should be taken that the windrowing is done before the canes are injured by frost and that the windrows are placed on ground so well drained that water can not stand about the buried canes. In northern Florida the canes are often left standing in the field until the new growth starts in the spring, being cut only as wanted for feeding. In addition to its use as a forage plant Japanese sugar cane is often used for making sirup, a grower in central Mississippi reporting a yield of 750 gallons per acre, though the Louisiana cane is usually preferred for that purpose in localities where both can be grown. It is grown quite commonly in Florida and from central Georgia westward to central Mississippi. Its cultivation is extending westward through central Louisiana and Texas. (Fig. 2.)

NAPIER GRASS.

Napier grass is a plant of recent introduction which promises to be of great value for soiling, for silage, and for grazing. It is a perennial, growing in clumps like sugar cane and reaching a height of 15 to 18 feet. (Fig. 3.) The leafy stalks are numerous, sometimes a hundred or more in a clump where the plants are not crowded. The small seeds are produced in long and slender spikes, resembling those of cat-tail millet. The seeds germinate freely, but the usual method of propagation is by the use of the stalks, much as sugar cane is propagated. When well-matured canes are used for planting they may be cut to single joints, cutting about an inch below each eye These pieces are planted by pushing them down into freshly prepared ground until the upper end of the piece is about level with the surface of the soil and the eye is down to where the soil is constantly moist. Such planting has been done very successfully in Florida in November and December, but farther north spring planting, using two or three joints to each piece, has been more common. On very rich soil the hills should be about 6 by 6 feet, but on thinner soils they may be closer. The crop has been grown successfully as far north as Charleston, S. C., and has made heavy yields in southern Mississippi. When the canes are to be kept through the winter they should be windrowed like sugar cane.

Napier grass is of special value for soiling, as it is eaten greedily by cows, bears frequent cuttings well, and grows very quickly after being cut. When used for the silo it should be cut twice during the season, once before July when the stalks have reached a height of 10 to 12 feet, and again just before frost, as that will give a larger total yield and the silage will be of better quality.

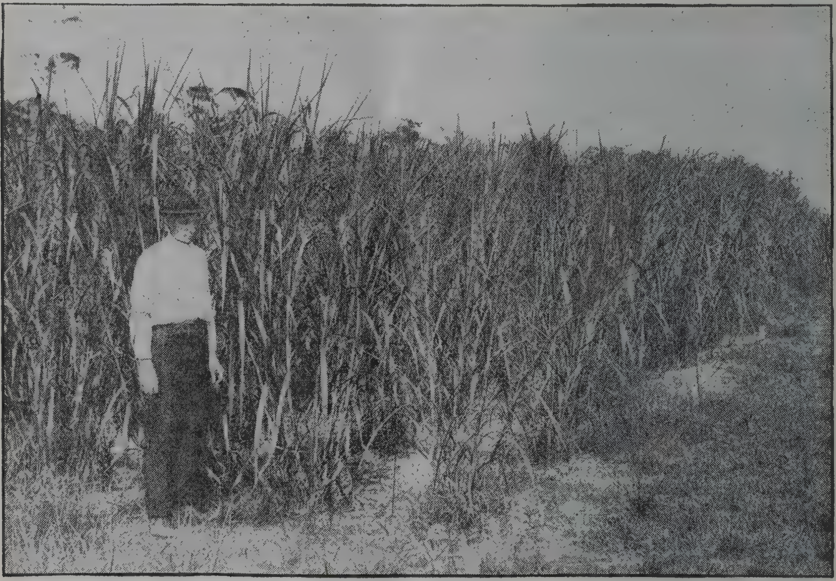


FIG. 3.—Napier grass, 3½ months old.

Merker grass is a variety of Napier grass that differs in having a more slender and more glaucous stalk, more nearly erect, slightly narrower leaves, and more numerous spikes that ripen much earlier in the season. There seems to be little difference in yield or in hardiness.

LEGUMES.

Leguminous plants, those belonging to the pea and clover family, should be grown in every permanent meadow and pasture, as they make a large increase in the total yield, their mixture with the grasses makes the feed of better quality, and their cultivation increases the productivity of the soil. Many of them are annuals and so can be used as catch crops. Some make their growth during the summer, others grow only during the winter, while still others are perennial and continue a vigorous growth for many years. Many of the annuals reseed the ground freely, and so are easily grown from year to year. Few of the perennial sorts bear grazing as well as some of the grasses, but some of the annual sorts are among the best of pasture plants. The hay made from legumes is especially valuable for young and growing animals, for animals which are being fattened, and for those which are not doing hard work. For hard-working animals, like livery horses and farm teams during the planting and cultivating season, hay made from grasses or a mixed hay is preferable to one made wholly from legumes.

The legumes are not only valuable for hay and pastures, but they are also the best plants which can be used for green manuring, which is of the highest importance in the cotton region, where the supply of humus and consequently of nitrogen in the soil becomes exhausted rapidly with the clean cultivation given to cotton and corn and the constant warmth of the soil. In few other parts of the country is green manuring more necessary or more profitable than in the South, and the growing of legumes provides a large part of the fertilizer needed for other crops. On this account some legume should be included in every system of rotation.

ALFALFA.

Alfalfa is undoubtedly the best legume for permanent meadows in localities where it will succeed, but it does well in only a small part of the cotton region. For its profitable growth it needs a rich well-drained soil containing an abundance of lime and having an open subsoil. Such soils are found in the black-prairie region of Alabama and Mississippi, in the alluvial regions along the Tennessee, Mississippi, and Red Rivers, in northeastern Texas, and in the Rio Grande region. Good alfalfa soils are also found on many river and creek bottom lands where the adjacent hills are of limestone. Alfalfa has not been satisfactory when grown on dry clay uplands; and on sandy soils it may make two or three good cuttings, but usually disappears before the end of its first year. It has not been grown successfully in the pine woods or in Florida and the Gulf coast region, where it may make a good growth in the spring, but is soon smothered out by crab-grass. Soils which are otherwise suited to its growth but are low in lime content may be made to produce good yields by an application of lime. The application should be liberal, not less than a ton of burnt lime or 2 tons of ground limestone per acre.

Seeding may be done from August to October or from February to April. Fall seeding is generally to be preferred, as weeds are then less troublesome and a full crop can be obtained the next spring. On the black prairie soils of Alabama and Mississippi spring seeding is the almost universal practice. This is partly because the fall is usually a dry season, partly because weeds give little trouble on these soils, and partly because the alfalfa is often sown on land which was in cotton the previous season and could not be made ready in time for fall planting. A good preparation of the land for seeding is to grow a crop of cowpeas or soy beans during the previous summer. Before planting the cowpeas, the ground should be plowed as deep as possible and then harrowed smooth, that there may be no low spots where water will stand and in order that a mowing machine can run over it easily. As soon as the crop of cowpeas or beans is gathered, the ground should be disked or plowed very shallow and then harrowed until the surface is fine and mellow, after which the alfalfa seed is sown at the rate of 25 to 30 pounds per acre and covered by rolling or light harrowing. Deep plowing just before seeding is never a good practice, as it leaves the subsoil in such a loose condition that the plants are more easily thrown out of the ground by winter freezes and suffer more seriously in summer droughts. Heavy seeding, as above indicated, is always preferable in the South. One can not afford to imperil obtaining a full stand for the sake of saving a little seed. In many cases the crop rotation is such that seeding can not be done in the fall, as when cotton or some other late crop occupies the ground. In fact, some growers prefer to plant on old cotton land because of its freedom from crab-grass and other weeds. If such land is to be used it should be plowed deep as early in the fall as the cotton can be picked. If this fall plowing is impracticable the spring preparation should be a disking only, as young alfalfa plants do not bear drought well when the roots have not reached a firm subsoil. Deep plowing should not as a rule be done within three months of the time of seeding.

In all cases the soil should be inoculated with alfalfa bacteria. This is best done by the use of soil from an old alfalfa field. Soil from a bur-clover or a melilotus field will answer the same purpose. This inoculating soil should be scattered over the new field at the rate of about 200 pounds per acre just before the seed is sown and harrowed in immediately. Where inoculated soil can not be obtained, artificial cultures of the bacteria may be used. In this event it is advisable to plant but a small patch of alfalfa, as the cultures are not always successful and one is not warranted in taking the risk on a large field. If the small patch is successful it will furnish an abundance of soil for further inoculation. Land which has grown melilotus or bur clover within two years does not need inoculation. Most alfalfa fields, even those on soils containing considerable lime, are usually improved by an occasional top-dressing of lime.

When sown as early as August, alfalfa in a favorable season will often give a fair cutting of hay in December and may be expected to give three to six cuttings of about 1 ton each the following season, but if sown in the spring one or two cuttings are all that can be expected the following summer. Many planters use alfalfa for grazing hogs and find it very profitable. When a field is used for continuous grazing it requires care to keep it in good condition. It should not be overstocked late in summer or it will be seriously injured. In the spring and early summer a good field will carry 12 to 15 pigs per acre, or about 1,000 pounds, live weight, of hogs per acre, and the animals will make a fine growth. Later in the season the number should be decreased or all removed, so as to give the alfalfa a few weeks of rest. The pasture should be supplemented with a ration of at least 2 pounds of grain a day for each hundred pounds of live weight.

MELILOTUS.[1]

Melilotus, or Bokhara clover, the white sweet clover of the North, is a close relative of alfalfa and is an important hay and pasture plant on soils which are rich in lime and are not of sufficient depth or are in too poor a mechanical condition for alfalfa or red clover. It is most abundant in the black-prairie region, where it makes a luxuriant growth, even in places where the lime rock is covered with only a few inches of soil. If cut while the plants are young, as soon as they begin to make flowers, the hay, except for its odor, can hardly be distinguished from alfalfa; and as it will give two or three good cuttings in a season it is a valuable hay plant. If, however, the plants are allowed to become too old and mature before they are cut, many of the leaves will drop, the stems will be hard and woody, and the hay of poor quality It is also one of the best pasture plants for dry limestone hills, as it begins its growth early in spring and continues in an eatable condition through the entire season. After a field is once seeded it continues to produce two crops each season if undisturbed. In many parts of the country it is regarded as a worthless weed and is not readily grazed by horses or cattle, but it is not so in the South, where it grows on a soil unsuited to most other grazing plants and where it is eaten as freely as alfalfa or clover. Seed may be sown in September and October or in February and March at the rate of half a bushel of unhulled seed or 20 pounds of hulled seed per acre. Usually but one cutting for hay can be made the first season, but the second season it will commonly give three cuttings of 1 to 2 tons to the acre each. The roots are very large and grow deep, and as most of them die and decay at the end of the second year they leave the soil in fine condition for cotton or corn.

---

[1] Coe, H. S. Sweet clover: Growing the crop. U. S. Dept. Agr., Farmers' Bul. 797, 34 p., 11 fig. 1917.

——— Sweet clover: Utilization. U. S. Dept. Agr., Farmers' Bul. 820, 32 p., 13 fig. 1917.

——— Sweet clover: Harvesting and thrashing the seed crop. U. S. Dept. Agr., Farmers' Bul. 836, 23 p., 13 fig. 1917.

ANNUAL YELLOW MELILOTUS.

Annual yellow melilotus is closely related to white sweet clover, but it does not grow so large, has yellow flowers, and is an annual which reseeds the ground freely. It grows most abundantly on the alluvial soils near the Gulf coast, where it is often very abundant in old rice and sugar-cane fields, making its principal growth in late winter and early spring, at which time it is grazed freely. It makes a hay nearly or quite as good as alfalfa, but as it usually grows in cultivated fields which are too uneven or too wet for mowing it is seldom cut for that purpose.

Although it is seldom cultivated, it is everywhere a desirable volunteer crop, as it gives good grazing very early in the season and adds large amounts of humus and nitrogen to the soil.

RED CLOVER.

Red clover in the South grows best on the alluvial and black-prairie soils and is seldom profitable when sown on sandy pine-woods soil or on dry clay hills. It requires a moderately rich soil having a fair amount of lime and in good mechanical condition. On sandy soil, even where it makes a good start, it is usually choked out by crabgrass and other weeds before the end of the first season. Even on good soils it rarely lasts more than two years, but it yields so heavily and its hay is of such good quality that it is a profitable crop on all soils suited to its growth. Land should be prepared as for alfalfa and the seed sown early in the fall, not later than the middle of September in any part of the cotton region, so that the plants may become well rooted before winter. Red clover will then make a rank spring growth and give a heavy cutting, 2 to 2½ tons, in May, a lighter cutting in June, and in favorable seasons another cutting in September, though the last cutting may be very light in seasons of a long summer drought. The following April or May it will give another cutting nearly or quite as heavy as the first, after which the ground should be plowed and used for corn or some other crop, as few of the clover plants will live through the second summer. When sown in the spring the yield will be very light the first year, the first cutting being principally of volunteer grasses and weeds, though one or two fair cuttings of the clover may be made later and a heavy cutting the following spring, but the total yield from the spring seeding will be much less than a fall seeding. One bushel of seed should be used for each 5 acres, and in the South it should never be sown with a nurse crop.

ALSIKE CLOVER.

Alsike clover varies greatly with the soil on which it is grown, making its best growth on rather low heavy soils, being quite persistent on dry clay uplands, and of little value on sandy soils having a low content of lime. It is a perennial similar to white clover in its general habit and persistency, but having nearly the size and vigor of red clover, which make it one of the best grazing plants on suitable soils. Its yield of hay is light, but it bears grazing well. Alsike clover is the best of the clovers for mixing with redtop for wet soils and will furnish good grazing long after the grass has stopped growing. It should be sown in August or September at the rate of 10 pounds of seed per acre.

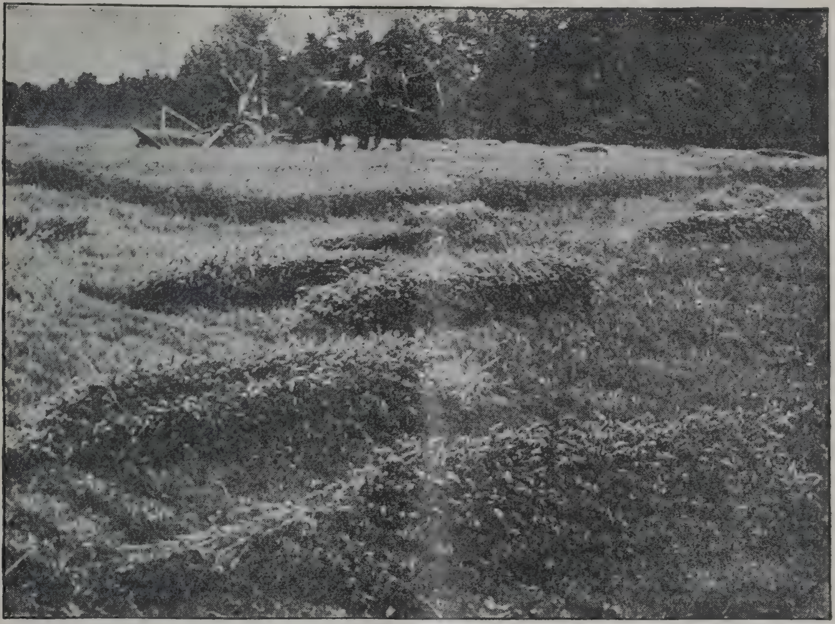


FIG. 4.—Crimson clover being harvested for seed with a reaper.

CRIMSON CLOVER.

Crimson clover is an annual which begins its growth with the fall rains, often giving good grazing from December to April, when it matures its seed and dies. It has succeeded better and seemed more at home on the Atlantic coast than farther west, though it has given good results in many scattering localities as far west as Louisiana. Inoculation is of great importance to its success, and many of its failures have doubtless been due to the absence of the proper bacteria. It is also very desirable that the seed be sown just before or after rain. Many of the failures in the western part of the cotton region are due to the dry weather which usually prevails during September and October. Under favorable conditions crimson clover reseeds itself even though the ground be plowed and used for some short summer crop like millet.

The hay made from crimson clover is of excellent quality if cut when the plants begin to bloom, but if cut after the seed begins to ripen it is an unsafe feed, as the hairs from the chaff about the seeds often form immense hair balls in the stomach. The crop gives good spring grazing for cattle and hogs, and it is a common practice to sow the seed between the rows of cotton and corn for winter grazing, for its value as a cover crop, and for its fertilizing effects. (Fig. 4.)

LESPEDEZA, OR JAPAN CLOVER.[1]

Lespedeza, or Japan clover, is an annual which is now grown in nearly all of the cotton region except on the light sandy soils of southern Florida. It thrives best on a soil with a fair amount of lime and one that is clayey rather than sandy, but it grows on all kinds of soil. On very thin or sandy soils its growth is usually so low and spreading that it can be used only for grazing, while on better soils its habit is more erect, reaching a maximum height of 30 inches and sometimes making a yield of 3 or 4 tons per acre. The hay is fully equal to that of red clover or alfalfa, as the stems are very slender and the principal bulk consists of leaves.

When grown for hay lespedeza usually follows oats. The oats are sown in September or October, and in February or March the ground is harrowed and the lespedeza seed sown at the rate of half a bushel per acre. The lespedeza makes little growth until after the oats are harvested, but it then continues to grow until killed by frost. When wanted for grazing, the seed may be sown at any time from December to March. Many planters secure it in their pastures by cutting some of the hay late in the fall and scattering it over the hilltops, thus seeding in spots, whence it soon spreads over the whole field. Lespedeza makes its growth late in the season, being of little value before May or June, but bears the summer drought well and continues to improve until killed by frost. It is the most widespread and most valuable self-seeding legume in the entire cotton region.

BLACK MEDIC, OR YELLOW TREFOIL.

Black medic takes its name from the fact that the small clusters of seed pods are black when ripe. It is called yellow trefoil on account of the yellow color of its flowers. The plant is usually a winter-growing annual, though it occasionally lives through the summer. Nearly its entire growth is made during the fall and winter months, mostly prostrate branches 1 to 2 feet long, and reaching only a few inches in height, and so is more valuable for pasture than for hay. It is quite hardy and bears heavy frosts with little injury.

---

[1] McNair, A. D., and Mercier, W. B. Lespedeza, or Japan clover. U. S. Dept. Agr., Farmers' Bul. 441, 19 p., 6 fig. 1911.

Its most important use is in permanent pastures, as it reseeds the ground freely and so needs to be planted but once. Seed should be sown in August or September, using 8 to 10 pounds per acre, and the ground should be disked or heavily harrowed in order to break the crust and make loose material which will cover the seed when the first rain falls. It is better to inocculate the seed before sowing. This can be done by mixing it with about an equal weight of soil in which alfalfa, melilotus, or bur clover has been grown. It is much like lespedeza in its growth, except that it grows in winter instead of in summer, but its tendency to lodge when the stems become more than a few inches in height makes it difficult to save for hay. It is an excellent crop for growing on Bermuda grass sod, as it is at its best at the time the Bermuda grass affords little feed.

COWPEAS.[1]

Cowpeas are grown more widely in the cotton region than any other cultivated leguminous crop and should have a place on every farm. The varieties differ greatly in habit and time of growth. Some produce long trailing vines, while others are usually erect and bushy in growth; some will ripen in two months from planting, while others require four or five months; even the same variety is greatly modified when planted on unlike soils or at different seasons. Cowpeas are inexpensive to grow and produce well on all soils except those which are very wet. They are excellent for hay or grazing and are the best summer catch crop for green manuring and improving soils. Though this crop will make a fair growth on very poor soil it responds quickly to an application of fertilizer, and as a heavy growth of cowpeas is the best possible insurance for a heavy following crop it pays well to use any fertilizer which will produce a thrifty growth of vines.

Cowpeas may be sown broadcast or in drills 3 to 4 feet apart, the first method requiring more seed and less labor, while the drills permit one or two cultivations, require less seed, are more easily mown for hay, and usually give a heavier yield. From 4 to 6 pecks per acre are used in broadcasting and from 2 to 3 pecks for seeding in drills, though even 2 quarts of some varieties are sufficient when carefully dropped by hand. A common and excellent practice is to sow cowpeas between the rows of corn at the last cultivation.

When cowpeas are sown broadcast with a small-growing variety of sorghum, like the Amber, using a bushel of the peas and half a bushel of the sorghum seed per acre, the mixture makes fine hay, and when sown in drills with a coarser sorghum, like the Orange, makes excellent silage.

---

[1] Nielsen, H. T. Cowpeas. U. S. Dept. Agr., Farmers' Bul. 318, 28 p., 8 fig. 1908.

Saving the hay in good condition is usually a difficult matter in unfavorable weather, and for that reason the planting should be done at such a time that the crop will mature during the dry weather usually prevailing during September and October. To make the best hay the vines should be cut as soon as the earliest pods become yellow, though the work may be delayed a few days if rain should threaten. When cut at that stage, the vines cure much more easily and rapidly than when cut earlier, the total yield is at its heaviest, and the hay will be eaten readily and will have a higher nutritive value, though it may not be quite so tender.

A common practice in saving the hay is to start the mower as soon as the dew is off in the morning and run it until noon. As soon as the upper surface of the cut vines is well wilted a tedder is run over the field to turn the vines over and expose them more thoroughly to the sun and air. If the crop is very heavy this may have to be done twice. When a tedder is not available the work can be done with a pitchfork, but this is slower and more expensive. Vines which have been cut in the morning and turned in the afternoon will usually be dry enough to put into small cocks the following afternoon, and if the weather promises to be favorable they should be left in these cocks two or three days before they are hauled to the barn. If it rains before the vines are put in cocks, they should not be touched until the surface is well dried and then they should be turned as though freshly cut. If the hay is handled promptly and properly a light rain does very little harm, even after curing has begun, and a heavy rain may fall on freshly cut vines and do little or no damage. The vines should be handled as little as possible; otherwise many of the leaves will drop and be lost. When the weather is fair and settled the freshly cut vines are sometimes rolled into bundles as large as can be handled easily with a pitchfork and allowed to lie in the field until thoroughly dry. This method saves labor and prevents any loss of leaves, but the tangled bundles are hard to dry if they should be wet with rain. When peas are grown with corn and are wanted for hay it is best to cut the vines and stalks together and make into windrows the same day. The cornstalks prevent the vines from packing closely, so that they dry more quickly. Such hay can often be put in the barn safely two days after it is cut. Cowpea hay is often cured by stacking the wilted vines around poles 4 to 6 feet high with two or three crosspieces nailed on each. A still better device consists of four poles 6 feet long joined at the top and held 4 feet apart at the bottom by means of crosspieces on which the vines are piled so as to cover the pyramid. The object of both devices is to permit the air to circulate more freely among the vines and so dry them with very little handling and loss of leaves.

When fed on well-cured cowpea hay containing a fair number of matured pods, horses and mules will keep in good condition through the winter with no grain feed.

The selection of the variety for planting should be determined by the use to be made of the crop. If a heavy yield of hay is the principal object, a vigorous upright variety, like the Whippoorwill or the Groit, is best. If the crop is to be pastured or left to decay on the ground through the winter, any of the trailing sorts, such as the Black, Red Ripper, and Unknown, are good. The Blacks are especially esteemed for this purpose, as the seeds do not decay easily. Where land is infested with wilt or with root-knot, only varieties resistant to these diseases, such as the Iron and the Brabham, should be used.

SOY BEANS.[1]

Soy beans have been cultivated in this country more than 100 years, but it is only within the last few years that they have become an important crop. They are grown both for forage and for seed. The number of varieties is very large, and they differ greatly in habit, in maturity, in color of flowers, and in color and size of seeds. The varieties may be strictly erect, with few or no branches, widely branched and bushy, or viny; some ripen within 85 days of planting, while others require six or more months to mature; in certain varieties the flowers are white, while in others they are purple; the seeds are cream, yellow, green, brown, or black.

Soy beans succeed on the same kinds of soil as does corn, and they are less injured either by drought or excessive moisture. They are not as well suited to very poor soils as cowpeas are, though they will do well on a soil too poor for corn. When planted early in the season the soil should be prepared as for corn, making the surface as smooth and fine as possible, but when planted after oats or early potatoes a thorough disking is all that is needed. Fertilizers are not usually profitable, though the yield is often increased by an application of acid phosphate.

Soy beans may be planted fully as early as corn, or the planting may be delayed until about three months before frost is expected. In most of the cotton region, plantings made from April to June are the most successful. Under ordinary soil conditions the planting should be very shallow, not more than 1 inch, but may be 2 or 3 inches where the soil is very light. If soy beans have not been grown on the land previously, the seed should be inoculated. The quantity of seed needed will vary with the size of the seeds and the size of the plants. For the smaller growing sorts, like the Ito San, which should be planted in drilled rows 2 to 3 feet wide with the plants 2 to 4 inches apart, from half to three-quarters of a bushel of seed should be used to the acre, but with the coarser growing sorts, like the Biloxi, which may be planted 18 inches apart in 5-foot rows, 2 quarts will plant an acre. It is nearly always better to plant in rows, so that at least one cultivation can be given, as the crop seldom makes a satisfactory growth when broadcasted. The choice of a variety for planting will depend principally on the use which is to be made of the crop. Soy beans are often planted with corn, either in alternate hills or in alternate rows. They are sometimes planted with corn for silage, and in that case a variety which will ripen at about the same time as corn should be used, but if not wanted for silage it is better to plant a variety which will ripen some weeks later, as it will be less injured in gathering the corn. The yield of seed may vary from 15 to 50 bushels per acre, 25 bushels being probably a fair average.

---

[1] Morse, W. J. Harvesting soy-bean seed. U. S. Dept. Agr., Farmers' Bul. 886, 8 p., 7 fig. 1917.
—— The soy bean: Its culture and uses. U. S. Dept. Agr., Farmers' Bul. 973, 32 p., 15 fig. 1918.

The feeding value of the beans is very high, as they contain more protein than cotton seed, the average protein content of 20 varieties being 39.15 per cent. The oil content is also very high, so that pork made from hogs fattened on soy beans, as also with peanuts, is likely to be soft; but when soy beans are grazed by hogs in the fall and the hogs are then fed on corn for a month or so the pork will be hard and in prime condition. The oil can be extracted from the seed by essentially the same methods used to extract cottonseed oil, and it commands a high price for industrial purposes. The cake which is left after the oil is extracted is used in the same way as cottonseed meal and is also a valuable feed.

Soy beans should be harvested for hay as soon as the pods are well filled. If wanted for seed the cutting should be delayed until the leaves fall, but not longer, as most varieties shatter seed after ripening. Thrashing can be done with an ordinary thrashing machine by taking out a part of the concaves and running very slowly. Several machines especially designed for the purpose are now on the market. When there are only a few beans to thrash a flail will prove very satisfactory. Special harvesters for gathering the seed from the plants in the field are now quite generally used in sections devoted to seed growing. After thrashing, the seed should be thoroughly dried and aired before being stored away, and seed more than a year old should never be planted without first being tested for germination. The material left after thrashing makes a fair quality of hay.

VELVET BEANS.[1]

The velvet bean is the most vigorous growing annual legume cultivated in the United States, and the area of its profitable cultivation is very nearly the same as that of the cultivation of cotton east of Texas. Velvet beans were grown in Florida at least 40 years ago, but at that time only one variety, the "Florida," was known, and as it seldom matured seed in any other part of the country and its agricultural value had not been discovered, it was used mainly as an ornamental climber. About 1907, several other sorts, most of them from southern Asia, were introduced by the Department of Agriculture. Other varieties were produced by crossing and hybridizing, and there are now many varieties, differing from each other greatly in length of season required for ripening, vigor of growth, form of pod, color of flowers and seeds, and in many other ways. Some varieties ripen so late that they can be grown only in southern Florida, while others ripen well as far north as Tennessee; some are so dwarf that they make only straggling bushes, while others make vines 50 feet or more in length. They produce two distinct types of pods, one covered with a dense, black, velvety pubescence, as in the Florida, Georgia, and Osceola varieties, and in the other type the pubescence consists mostly of short white or grayish hairs, as in the Lyon, Chinese, and Yokohama velvet beans. The pods of nearly all the gray-podded sorts have a tendency to split open and scatter the seeds when left long in the field after ripening, but the black velvety pods seldom shatter. In most varieties the pods have more or less short bristles which cause a slight irritation of the skin when handled. The pods of some varieties are only 2 or 3 inches long, and in others they are 4 to 6 inches. The seeds may be of almost any color, from white to mottled brown or black. All the varieties need practically the same treatment, and the choice between them will depend largely on the locality where they are to be grown. It is an almost invariable rule that the earlier a variety ripens the smaller will be the growth of vine and yield of seed, so the strongest growing variety suitable to the locality should be selected. In a locality where the late-ripening sorts will mature if planted early, one of that sort should be used for plantings made early in the season. Velvet beans are not eaten readily until well after maturity, and as they are wanted mostly for winter grazing and no fall crop can be planted on the ground where they are grown, it is best to select a variety which will not mature until about the time when a killing frost is expected, so that the ground may be occupied by a growing crop during the entire growing season.

---

[1] Tracy, S. M., and Coe, H. S. Velvet beans. U. S. Dept. Agr., Farmers' Bul. 962, 39 p., 14 fig. 1918.

All the varieties of velvet beans except the bush variety require a support of some kind in order to make the greatest production of seed. Corn serves the purpose well and so is commonly used in the place of poles, which would be better but are much more expensive and troublesome. Planting with corn is the best and most profitable way in which they can be grown. The beans are often planted in the same rows and in alternate hills with the corn. This is an excellent method when one of the smaller growing sorts is used or where the crop of both corn and beans is to be used for silage. By this method the growth of the corn is affected very little and its gathering scarcely interfered with. When a larger and stronger growth of vine is wanted it is better to plant the beans in alternate rows with the corn, putting the rows only about 3 feet apart, or, still better, planting two rows of corn to one of beans. Planted in the last way the beans interfere little with gathering the corn, and even when large-growing sorts are planted in the rows with the corn they make little trouble if the corn is not gathered until after frost has caused the leaves of the beans to drop. (Fig. 5.)

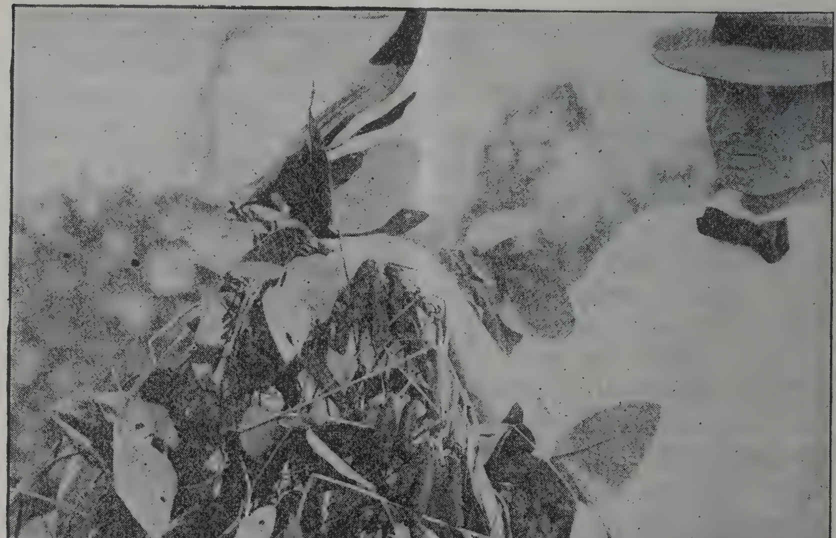


FIG. 5.—Velvet beans grown in mixture with corn.

The rate of seeding will vary with the purpose for which the crop is grown. When velvet beans are planted with corn and it is desired to secure as much corn as possible, they should not be planted so closely as to interfere with its growth, and from 2 to 3 quarts per acre will be sufficient, but if a heavy crop of beans is wanted and the corn is not of first importance, twice as much seed should be used. These quantities are for the small-seeded sorts, such as the Florida and Alabama, while for the larger seeded sorts, like the Chinese and Osceola, the quantities should be nearly doubled. When planted to make the heaviest possible quantity of vines, either for green manuring or as a smothering crop, from half a bushel to a bushel of seed should be used.

The growing of a smothering crop of velvet beans is the easiest and most effective method known for the eradication of Bermuda grass and other weeds, and at the same time it gives a large amount of winter grazing and puts the land in the best possible condition for succeeding crops. When used for this purpose the vines should be given no support.

The vigorous growth of velvet beans together with their large yield of seed, which may be gathered or allowed to remain in the field without much injury during the autumn and winter, permits this crop to be utilized in a number of different ways.

Velvet beans are seldom used for hay, as the vines become so long and tangled that it is very difficult to handle them. But if used for this purpose it is necessary to cut the vines before many of the pods mature, in order to save the leaves, which are lost rapidly from this time until maturity. The hay is rough and coarse at best and is not relished by horses and mules. Yields of 2 to 3 tons per acre may be obtained.

Velvet beans have been employed to some extent in the making of silage, and for this purpose early-maturing varieties like the Alabama are commonly used. With such a variety most of the vine growth is wrapped about the cornstalks, and little trouble is experienced in cutting the corn with corn knives and in running it through the silage cutter. Silage made from this mixture turns black after it has been in the silo for a short time, on account of the juices in the velvet-bean plants, but this apparently does not impair its keeping qualities or feeding value. Stock eat silage made from this mixture as readily as that made from corn alone. Dairymen who have used this mixture speak highly of it and now use it in preference to silage made from corn or sorghum alone. When the silage is cut so early in the season that the bean vines have not become weakened by age they will often make a thrifty second growth and mature a fair crop of seed.

The most important use of the velvet bean is as a grazing crop for cattle and hogs in the autumn and winter. It is not grazed well by horses and mules or by any stock until after it has been well matured or frosted. As the leaves, vines, and pods decay slowly when subjected to weather conditions, velvet beans will furnish feed until early spring. It is usually better to let the crop stand until it is killed by frost, as the leaves will be off the plants at that time and the corn may be gathered with less difficulty. The beans needed for seed should be gathered before live stock are turned into the field. The amount of grazing which will be afforded will, of course, depend upon the growth of the crop and the quantity of corn which is not gathered, but it is the custom with many cattlemen to allow one-third to one-half an acre per month for each steer or cow. The usual period for pasturing velvet beans is about three months, but this may be shortened or lengthened, as deemed advisable. When the acreage of beans is large and there are not sufficient cattle to stock the pasture at this rate, the grazing is often continued for four or five months, but there is necessarily some loss of feed through decay. Hogs should be permitted to follow the cattle, as they will consume practically all the beans which have been broken from the plants and wasted by the cattle. A common practice is to allow one or two hogs in addition to the cattle for each acre of beans.

On the heavier soils there is some danger of packing the land if grazing is continued in rainy weather. On this account pasturing on such soils should be done with more care than on sandy lands.

A good stand of velvet beans should produce about 200 pounds of beef and 100 pounds of pork per acre. When hogs alone are grazed the yield of pork should be 300 to 500 pounds per acre. Velvet beans are not a perfectly safe feed for pregnant sows, as apparently they sometimes cause abortion, nor for very young pigs, on which they sometimes cause sores, but they are perfectly safe for all other animals. Many breeders claim that the beans are never injurious when the sows have constant access to water. Cattle eat the entire plant, including the pods, but hogs reject the pods, so it is better to have cattle precede the hogs in grazing. As the beans contain relatively little oil they do not make the pork soft, as is the case when hogs are fattened on cowpeas and peanuts.

The pods and seeds are sometimes gathered and ground into meal for feeding cattle and hogs, but as hogs do not like the pods the meal must be ground very fine or they will not eat it. Cattle eat the meal with relish, but it is doubtful whether the grinding pays for its cost, as tests made at several of the southern experiment stations show that there is little difference in feeding value between the whole beans and pods and the meal. When the beans and pods are fed to cattle they are eaten better if soaked in water for 12 hours before feeding, as they can then be masticated much more readily.

VETCHES.

Of the many kinds of vetch that have been tested in the cotton region only three, the hairy, the common, and the Augusta, have come into general use there. All are winter-growing annuals and reseed the ground so freely that with proper management they may perpetuate themselves indefinitely. The hairy vetch is the strongest growing of the three and produces the heaviest yield. All prefer a soil containing a fair amount of lime.

Hairy vetch does well in all the black prairie and alluvial regions, where it is usually grown with winter oats or rye. Seed is sown in September or October, using about a bushel of oats or half a bushel of rye and from a peck to half bushel of the vetch. In favorable seasons the crop will give good grazing from December to March, after which the stock should be taken off to give the vetch a chance to mature seed. When the vetch seed begins to ripen, about May, the mixture will yield about a ton per acre of hay which is of the very finest quality, and enough of the vetch seed will be scattered on the ground to reseed the field for the following season. During the summer the ground may be used for corn, millet, or any other short-season crop and if plowed and reseeded with oats in September will make a better yield than in the previous season. On lands set in Johnson grass some growers plow after the last cutting in September and seed with vetch and oats. This gives good winter grazing, a crop of mixed vetch and oat hay in April or May, and two heavy cuttings of Johnson grass during the summer, after which the ground is again plowed and seeded with oats only, as the vetch does not usually need reseeding. (Fig. 6.)

FIG. 6.—Hairy vetch growing at Arlington Farm, Va.

Augusta vetch needs about the same treatment as hairy vetch. However, it is much more persistent in meadows not given cultivation and is one of the best kinds for pasture lands. It is one of the earliest maturing of the vetches. On bottom lands producing Johnson grass hay in the summer, Augusta vetch in combination with other volunteer winter annuals, such as hop clover and grasses, occupies the land in winter to advantage and produces winter pasturage or an early crop of hay. The seed of this vetch is small, and about 30 pounds per acre is all that is required in sowing.

Common vetch is used more or less throughout the South, but has not given consistently good results. The strains of common vetch differ in winter hardiness and other characteristics, and these differences may account for the varied success. In general, common vetch is handled the same as hairy vetch. Its seeding rate, however, should be about 60 pounds to the acre.

All vetches grow much more vigorously and seed much more freely when grown with oats or some other crop which at least partly supports the vines, as they make a poor growth and do not seed well when lying flat on the ground.

Some of the native vetches, especially the Louisiana, occur in many meadows and are highly valuable, but their yield is so much less that their cultivation is much less profitable than the three mentioned.

When planting vetch for the first time it is necessary to inoculate the land by using soil from an old vetch field or by the use of cultures if soil is not procurable.

FLORIDA BEGGARWEED.

Beggarweed is an important forage plant from central Florida northward to southern Georgia and Alabama, and occasionally farther north. It is an annual which makes its growth late in the season at the time that crab-grass is growing most rapidly, the two usually being found together. The plant is erect and grows to a height of 5 to 7 feet on good soils. When cut at the right time and properly cured it makes a superior hay, but it must be handled carefully. If allowed to become too old before it is cut, many of the lower leaves are lost and the stems become woody. After cutting it should be windrowed as soon as wilted, to prevent the leaves from dropping. To make good hay it should be cut when not more than 3 or 4 feet high, usually in July, and a second cutting can be made a few weeks later. Although not sufficiently bulky for use in filling a silo, a little of it mixed with other material adds greatly to the value of the silage, as it gives a marked June flavor to butter even when used in midwinter. Its greatest value, however, is as a grazing plant in late summer and early winter, it being even more fattening than alfalfa or cowpeas.

Florida beggarweed usually makes a scattering and uneven volunteer growth on land which has not been plowed during the year, though when occasional strips are left standing at the second cutting and the field in then harrowed crosswise to scatter the seeds a good crop is grown the second season after plowing. The better practice is to reseed the ground after oats, melons, or some other early crop has been removed, using 20 to 30 pounds of the rough seed per acre.

In the region where it is grown most commonly beggarweed is seldom seen as a volunteer crop on newly cleared lands, but is more or less abundant, growing with crab-grass and Mexican clover in nearly all old fields, especially in corn and cotton, where it springs up after the crops are laid by and furnishes a large amount of good grazing after the crops have been gathered. Some cotton growers object to it in their fields, as the immature seeds are somewhat rough, and when the stalks are switched about by the wind the seed cotton is often pulled from the bolls.

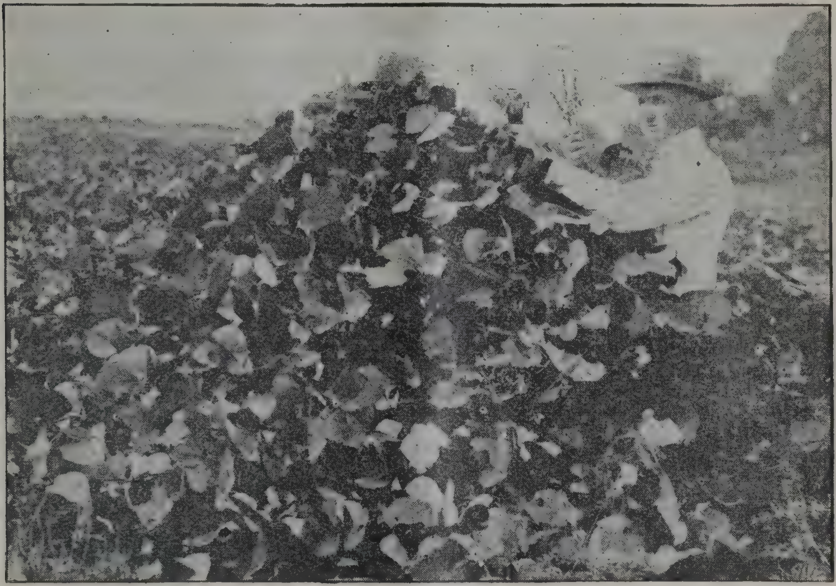


FIG. 7.—Kudzu, showing its heavy vegetative growth.

Beggarweed is easily killed by a single cultivation in late summer and soon disappears from fields which are not plowed. Although it is a crop of secondary importance and seldom used alone, it is a welcome addition to any hay crop, and when so abundant as to afford good grazing it will fatten horses, mules, and cattle more rapidly than most other plants.

KUDZU.

Kudzu[1] is a large-leaved, woody, leguminous vine, native to Japan, which grows with remarkable rapidity. It succeeds better on clay soils or soils with a clay subsoil than on sandy soils. Where the summers are warm and moist it grows with great luxuriance.

---

[1] *Pueraria thunbergiana.*

(Fig. 7.) Kudzu is a most excellent vine for arbors and porches, for which purpose it is grown in most of the southern cities, climbing to a height of 60 feet or more. It succeeds well, however, as far north as Nova Scotia. The leaves resemble in a general way those of the common bean, but they are larger and angular lobed, besides being tougher in texture; the stems and leafstalks are somewhat hairy. As far north as Washington the vine will bloom, but only occasionally and then late in the fall. The blossoms are dull purple-red and hang in clusters. The pods are thin, very hairy, and rarely mature in the latitude of Washington. Kudzu is usually propagated by layers or roots. The vines are very long, and take root at any joint which rests on the ground. It can be grown from seeds, but the young seedlings are very weak and tender, so roots are preferred. The roots are usually planted about 8 by 8 feet in cornfields, and if the corn is kept well cultivated no attention need be given the kudzu during its first season. Planting should be done very early, January or February being the best months, as it begins its new growth very early in the spring, after which the transplanting is seldom satisfactory. During the second season no other crop can be grown on the land, and the kudzu should have the ground well covered with vines and roots. Under favorable circumstances a moderate cutting of hay may be made, or it may be grazed lightly just before frost is expected. It is not until the third season that a full crop can be secured, but after that heavy, abundant crops may be expected. Though the vines are long and tough they are not especially difficult to handle. In mowing, a scythe blade or something similar should be fastened vertically to the outer end of the cutter bar so that the swaths will be separated. Raking is usually done with a fork, pulling the vines into small piles which can be handled easily in loading a wagon. When made into hay the vines retain the leaves much better than most other legumes, and the hay is injured very little by rain which may fall upon it when nearly or quite dry. The hay is usually rather dark in color, but is eaten greedily by all kinds of stock, being especially valuable for colts and calves. When grown on a rich soil, at least three cuttings of 2 to 3 tons each may be expected, and total yields of 10 tons are often claimed.

Kudzu is used more largely for grazing than for hay, most graziers preferring to have two fields which are grazed alternately, although the Georgia Experiment Station has made a series of tests which indicate that continuous moderate grazing gives the best results. It is not desirable for grazing dairy cows, as it often affects the milk unpleasantly. Some graziers prefer to let it grow through the summer and make a dense mass of vines and foliage, 2 to 4 feet deep, and then graze it during the dry weather of September and October when other pasturage is getting dry and scarce.

The principal objection to the plant is that it requires a long time to make full growth and that, being a perennial, it can not be used in a rotation. There are many places on rough and waste land, however, on which it can be grown to advantage, and it is easily killed by plowing in May or June.

PEANUTS.[1]

Peanuts are grown throughout the cotton region, as the crop requires about the same climatic conditions as cotton. A large proportion of the crop is harvested for the seeds, with the incidental production of much excellent hay, but to a large and increasing extent peanut crops are utilized by pasturing with hogs. (Fig. 8.)

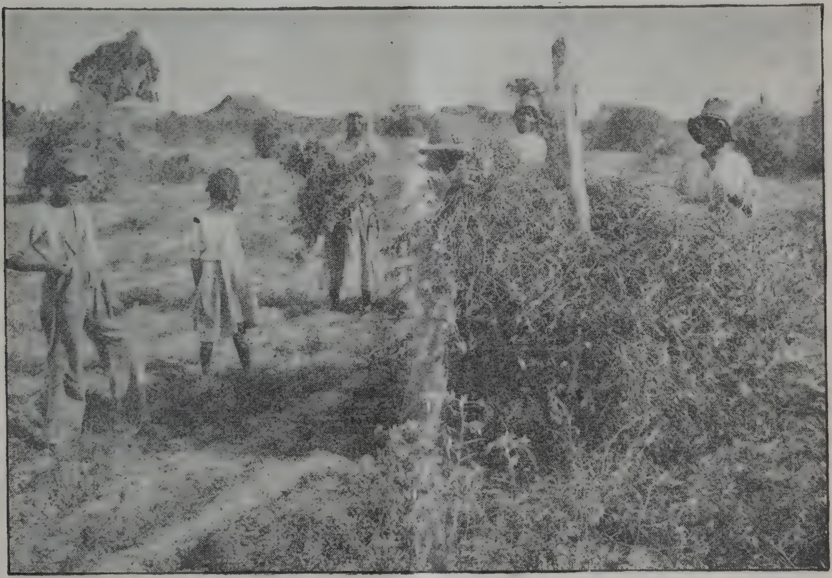


FIG. 8.—Piling peanuts for hay.

There are many varieties of peanuts, and all furnish excellent pasturage, but probably the best for forage purposes are the Spanish and the Valencia.

Hogs gain rapidly on peanuts, but the pork produced is soft and oily and so brings a lower price on the market.

MISCELLANEOUS FORAGE CROPS.

While grasses and legumes furnish by far the most important forages, other plants, especially those with tuberous roots or very succulent foliage, are often useful and desirable. Among those grown in the Southern States are Mexican clover, Jerusalem artichokes, chufas, sweet potatoes, cassava, and rape.

---

[1] Beattie, W. R. The peanut. U. S. Dept. Agr., Farmers' Bu. 431, 39 p., 20 fig. 1911.

MEXICAN CLOVER.

Mexican clover, sometimes called "pusley" or "purslane," though entirely different from the plant known by those names in the North, is not a true clover, but belongs to the same family as the madder, bedstraw, and a number of other common plants. It is an annual of much the same habit of growth and size as common red clover, but the leaves are opposite and simple instead of alternate with three leaflets. It grows most abundantly in cultivated fields from which early crops have been removed and often makes a heavy growth in corn and cotton after those crops have been laid by. It is seldom planted, as, like crab-grass and beggarweed, it makes a volunteer growth late in the season. It is doubtful whether the yield would be increased materially if it were sown early and the ground given up to it through the whole summer. It is common in old fields near the coast from Florida westward to Mississippi. It makes a fair growth on soils too poor for most other crops and may be used both for hay and for grazing. Although the hay is not of the best quality it is eaten readily by most farm animals, and as it is usually more or less mixed with crab-grass and beggarweed it adds largely to the bulk and value of an inexpensive crop. When used for grazing it is more valuable for hogs than for other stock, though eaten well by mules and cattle. It can be grazed from about June until after heavy frosts and will then reseed the ground abundantly.

The seeds are very small and difficult to save, though they are sometimes beaten out with flails or gathered from the bottom of a mow in which the hay has been stored. From 4 to 5 pounds per acre are sufficient for seeding, but the common method of distributing the plant is by mowing after some of the seed is matured and scattering the hay over the field on which the crop is wanted the following season. A planter in northern Florida who has grown beggarweed 15 years reports that he has kept 4 horses and 20 hogs in good condition for 8 months on a field of 7 acres. The field had been in oats the previous season and the growth was somewhat mixed with crab-grass and beggarweed but was mostly Mexican clover. A southern Mississippi grower states that these plants double the yield of his volunteer hay crop and that the mixture is worth fully as much as any hay he can buy.

Although it is not a nitrogen-gathering plant like the true clovers, the growth of Mexican clover is usually volunteer and so costs nothing. It protects the surface of the ground from the scorching sun in summer and washing rains in winter and adds humus to the soil. The plant should be regarded as an inexpensive substitute for something better rather than one to be sown and cultivated carefully.

CHUFAS.

Chufas are a profitable crop on sandy soils for winter grazing by hogs and poultry. They grow best on soils which are light and sandy and yield well with moderate cultivation. They involve no expense for gathering and storing except for the small number of tubers which may be wanted for the following season. Chufas should be planted in early spring about a foot apart in rows 3 feet apart or as close as they can be cultivated conveniently, using about half a bushel of tubers per acre. No special care is required except to keep the ground free from weeds. They can be used from September to January. Many growers claim that the tubers are more fattening than peanuts. The quality of the pork is no better than that produced by feeding peanuts.

RAPE.

Rape is an annual, very succulent plant belonging to the same family as the collard and having much the same habit of growth. It grows well only during cool weather, bearing severe frosts without injury but languishing when hot weather comes. It is especially desirable for cattle, sheep, and hogs and is usually pastured. It should be sown as early in the fall as the nights become cool, or about September, and will then be ready for grazing in six to eight weeks. Later sowings will furnish grazing until late winter, and very early spring sowing will give late spring feed. It is seldom profitable to sow rape later than April 1. It should be sown on a rich soil such as would be used for growing cabbages, planting in drills, so that it can be cultivated at least once, and 3 to 5 pounds of seed should be used per acre. The variety known as Dwarf Essex is the best for general use. Cattle and sheep should be grazed carefully at first, as overeating is liable to cause bloating, and dairy cows should be grazed on it only soon after milking, as when grazed just before milking the rape is likely to give the milk an unpleasant flavor. Hogs may be grazed on it indefinitely without danger of injury.

SWEET POTATOES.

Sweet potatoes are very easily grown and make heavy yields in all the pine-woods regions and in other sections having sandy soils. In the southern part of the cotton region they can be planted at any time from March until July, and so can be had ready for use from August until midwinter, though those planted early in the season do not yield as heavily or keep as well as those which are planted later. They are used quite extensively for grazing hogs, and as they make from 4 to 6 tons of tubers per acre and cost nothing for gathering they are an inexpensive feed for fall fattening. The vines make unusually good feed for dairy cows and should be used for that purpose whenever possible. They are so succulent that they are difficult to make into hay, but will keep in good condition for feeding for a long time after they are cut.

JERUSALEM ARTICHOKES.

Artichokes make a valuable grazing crop for hogs in the northern and central parts of the cotton region, but yield less heavily and are less desirable farther south. They require the same soil, methods of planting, and cultivation as Irish potatoes, but yield much more heavily and are worth fully as much for feed. They are strictly a winter feed, not being well matured until December. From that time until March they furnish perhaps the least expensive roots grown for hog feed. No special cultivation is needed except to keep down weeds. When the crop is matured, enough of the tubers for planting the next season should be plowed out and buried like potatoes, after which the hogs may be turned into the field. Though the hogs will leave a few of the tubers in the ground, it is not well to depend on them for a crop the following year, even when they are to be grown on the same ground. Such scattered tubers may make a fair stand, but they will be so irregular that the ground can not be cultivated and the yield will be small. It pays much better to plow the ground and to plant in regular rows.

Even with the most careful digging a few tubers will be missed, and these will make a volunteer growth the following season. Many farmers object to them on that account, but if the volunteer plants are plowed out or hoed off in midsummer after the old tubers have become exhausted and before the new ones have formed there will be no further growth. While artichokes alone are a poor ration either for growing or fattening hogs, 3 bushels of them fed with 1 bushel of corn are fully equal to 2 bushels of corn, and the fresh feed which they give keeps the animals in much better health than when fed on corn alone.

CASSAVA.

Cassava was formerly grown quite extensively from Florida and southern Georgia westward to southern Texas, but other root crops, especially sweet potatoes, can be produced at less cost in most of the region, so now the cultivation of cassava is confined almost wholly to central and southern Florida.

Cassava does best on light sandy soils, on which it yields 5 to 7 tons of roots per acre. The roots are similar in appearance to those of sweet potatoes, but are much longer and make an excellent feed for cattle and hogs. Cassava is propagated by sections of the old stems, which are cut into pieces 4 to 6 inches long and planted about 4 feet apart each way, the cultivation being the same as that given to corn. Cassava should be planted about the same time as cotton, the crop maturing from October to November. The roots will remain in the ground all winter in good condition, but as they decay in a few days after exposure to the air they should not be dug until wanted. The stems which are used for planting are killed by moderate frosts and are difficult to preserve in good condition through the winter except in the extreme South. The best method of preserving them where heavy frosts occur is to cut them when well matured and bury them in a dry place where they will not become frozen.

HAY CROPS.

A good hay plant should make a large growth, be leafy, have fine and tender stems, be palatable, and grow so erect that it can be cut readily with a machine. If the meadow is to be permanent the plants should be perennials, while if temporary, annual plants are usually more profitable. If the hay is to be used exclusively for dairy cows, fattening stock, or for young and growing animals, the plant should be a legume, but the true grasses make a hay which is more satisfactory for livery horses and other animals doing hard work. If the hay is to be sold, of course the choice of grass will depend on the demands of the market to be supplied. It is often the case that hay can be made which is so palatable and nutritious as to be highly valuable on the farm, but so coarse and unattractive in appearance as to be almost unsalable on the market. Such hay should be valued by its feeding rather than by its market value. Cowpea hay mixed with cornstalks, cockleb, and ragweed may have little sale value, but it will keep mules in fine condition through the winter without the addition of any grain. For ordinary farm use hay made from a mixture of both legumes and grasses is more desirable for general feeding than hay made from either alone.

PREPARATION FOR PERMANENT MEADOWS.

In the cotton region, where a crop of good hay can be grown in almost any three summer months when the fields are not in use for other purposes, annual and catch crops furnish a large part of the hay, and permanent meadows are less important and less common than farther north, though they are profitable in many localities. The most productive meadows are usually those which contain at least two kinds of plants, one of them a legume which makes its best growth early in the season and the other a grass which gives its heaviest yield in the summer and fall. After a field has been used for such crops during two or three seasons the yield of hay is so decreased that it is usually better economy to plow and harrow or disk the field in the fall, after the last cutting for hay, which will leave it in the best possible condition for cotton or grain the following spring.

A permanent meadow requires a rich soil, thorough preparation of the ground, and constant care. Before it is planted the surface should be made smooth and even, so that there will be no ridges or ditches to interfere with the use of the mowing machine or the rake, and all low spots should be filled in or drained so that water can not stand to kill the grass. None of this work can be done after planting without serious injury to the stand. If the soil is not rich it should be made so by the use of stable manure or by the plowing under of a crop of cowpeas. Such fertilizing is usually much more effective than the use of commercial fertilizers, which furnish no humus, one of the greatest needs for the production of heavy yields of grass. If the land is too poor and thin to make a good yield of cowpeas it is too poor for a meadow, and if it can be made to produce a good yield of pea vines the success of the following hay crop is practically assured.

The profitable life of a meadow depends largely on the kinds of plants used, the character of the soil, and its treatment, the treatment being, perhaps, the most important factor. Where the growing season is nearly continuous the roots of any perennial hay plant soon become so numerous and densely matted that an occasional plowing and harrowing of a crop like Bermuda grass or Johnson grass is highly beneficial, and the disking of a crop like alfalfa will stimulate a more vigorous growth. No meadow can continue to make heavy yields without the use of fertilizers, which should be highly nitrogenous for the true grasses and rich in phosphoric acid and lime for the legumes. A winter top-dressing with stable manure is the best fertilizer for any meadow, but is not often available in the cotton region. Such manure should be applied after the last cutting in the fall and disked or leveled with a heavy harrow early in the spring. It makes little difference whether the disking precedes or follows the application of commercial fertilizers.

PLANTS FOR PERMANENT MEADOWS.

The best grasses and legumes for permanent meadows differ widely in different parts of the cotton region. In the northern section timothy does well in some localities, but it can not be depended upon farther south than Tennessee and the Carolinas. In the greater part of the cotton belt Bermuda grass and, in limited areas, Johnson grass are the more important plants for permanent meadows. The seeding with legumes (alfalfa, clover, and the like) and with the perennial grasses should be done early in the fall, if possible, so that the young plants may have time to become well established before cold weather and be ready to begin a vigorous growth with the first warm days of spring. No nurse crop should be used, as the early growth of the hay crop will need all the space before the nurse crop is ready for harvesting, nor should any permanent meadow be pastured during the first winter. Alfalfa and red clover make their best growth on land which is well suited to Johnson grass and usually more or less thickly set with it, and the mixture makes a meadow which is very productive of hay of fine quality; in fact, most feeders prefer this mixed hay.

If Johnson grass is already growing on the land where the meadow is to be established no further attention need be given it, the clover or alfalfa being seeded in the fall. Such meadows give two to four cuttings annually, the earlier cuttings being largely of alfalfa or clover, while the later cuttings will contain a larger proportion of Johnson grass. In the black-prairie region and on the heavy black lands of Texas, Johnson grass alone is used largely in permanent meadows, usually giving three annual cuttings. It is important that this grass should be cut as soon as it begins to head, both because it makes a finer and better hay at that time and because it then has no seed sufficiently mature to scatter the grass into fields in which the manure may be used. All Johnson grass meadows need an annual plowing to break up the hard surface and to prevent the roots from becoming so matted that growth is weakened. Many growers take advantage of this fact to grow other crops on the same ground. The grass is plowed in September or October after the last cutting and is then seeded with winter oats and vetch, usually for hay. After this is harvested two or three cuttings of the Johnson grass are made before the land is again plowed and seeded the following September.

For rich river and creek bottom lands Bermuda grass is one of the best hay grasses, as on such soils it makes a heavy yield, 4 to 6 tons per acre in three cuttings. As it starts rather slowly, it is better to plant some other crop on the ground at the same time the Bermuda grass is planted. If the ground is seeded with vetch, either the smooth or the hairy variety, the yield of the first cutting the following spring will be much increased and the quality of the hay greatly improved. When planted late in summer a quick growth can be obtained by sowing Italian rye-grass at the rate of 20 pounds per acre and covering it by light harrowing. The rye-grass will cover the ground in a few weeks, make excellent grazing or a moderate yield of hay the following spring, and then gradually disappear as the Bermuda grass occupies the ground. This use of rye-grass is specially desirable in the making of lawns and in securing an immediate growth of grass about the house. Bermuda grass forms such a dense mat over the surface and yields so heavily that the meadows need an occasional fertilizing and breaking up to keep them in the best condition. For such fertilizing well-rotted stable manure is the best thing which can be used. It should be spread evenly in the fall and then the field gone over early in the spring with a disk harrow set at such an angle that it will cut the matted sod but will not tear it up enough to leave the surface rough. If stable manure is not available cottonseed meal should be used, applying it immediately after the disking. Dallis grass is a valuable constituent of permanent meadows in certain localities, especially in the northern part of the cotton region, but on account of the high price of the seed it is seldom sown. Along the Gulf coast, particularly in Florida and southern Texas, Rhodes grass is one of the most productive grasses which have been grown; in sections of Florida where the soil is damp and mucklike, Para and Carib grasses are more productive than any others, while on the marshy lands in southern Louisiana the paille finne grass gives heavy yields.

TEMPORARY MEADOWS.

Temporary meadows of short-season annuals grown for hay are of much greater importance in the cotton region where crops may be grown throughout the entire year than they are in sections where the growing season lasts only six to eight months and the growing of such crops would interfere with the other regular crops on the farm. Both summer and winter crops can be used in this way. Not only can they be grown without interference with other crops, but they can also be made highly beneficial to the land by protecting it from washing rains and the scorching sun and, if legumes are used, by adding nitrogen to the soil.

Among the summer crops which can be grown for hay, cowpeas, lespedeza, beggarweed, Mexican clover, crab-grass, the millets, Natal grass, and the sorghums are the more important. Of these, all except sorghum may be grown during the last three months of warm weather and on land which has been used for some other crop earlier in the season. Crab-grass, beggarweed, Natal grass, and Mexican clover are usually volunteer crops, and though their yield is not often heavy, commonly not more than about 1 ton per acre, they are made with no expense except for the harvesting and so are very profitable. Cowpeas make a hay that is worth fully as much as red-clover hay, and it is generally believed that the expense of growing the crop is fully met by the effect on succeeding crops. The fertilizing value of cowpeas is so well recognized that many planters furnish the seed and the use of land free to their tenants for the increase which it gives to the following crop. A great deal of cowpea hay is made by planting the peas in the cornfields at the time of the last cultivation and then mowing both the stalks and vines after the corn has been gathered. Such hay looks rough and coarse, but is rich and nutritious.

Lespedeza is an important hay crop in many parts of Louisiana, Mississippi, and Alabama, and there is no apparent reason why it should not be equally profitable in other parts of the Gulf States having heavy lime soils. When grown for hay it is usually sown on oat land early in the spring and will then make a yield of 2 to 3 tons per acre after the oat crop has been harvested.

When it is desirable to secure a crop of hay in the shortest possible time one of the millets should be used, as they are ready to cut in 40 to 50 days after seeding.

Winter-growing annuals are used mostly for grazing, but they often make profitable hay crops. Among the best of them for hay are the vetches, crimson clover, oats, and wheat, all of which can be sown after a corn crop has been harvested and can be cut for hay in time for planting corn the following spring. Cotton occupies the ground so late in the fall and must be planted so early in the spring that hay can not be grown profitably on the same ground, though good grazing is often secured. The best hay which can be grown during the winter is a mixture of oats or wheat and hairy vetch, and when on a suitable soil the yield is from 1½ to 2 tons of dry hay per acre. While each of these three crops is often grown alone for hay, the yield is much greater and the hay much better in quality when vetch is grown with the grain. While it is easily possible to secure good yields of hay from a winter crop, the practice of growing such a crop is not likely to become general, since it matures at a season when it cures slowly and when the farmer is usually crowded with other work.

MAKING HAY.

The best time for cutting hay differs almost as much as the methods of curing. Most grasses should be cut as soon as they are well headed; the millets and Johnson grass should be cut as soon as the heads begin to show from the boot, but the winter grains should stand until the seed is in the milk stage. Legumes like cowpeas and soy beans, in which the seed is an important part of the forage, should not be cut until the earliest pods begin to mature, but perennial legumes, such as alfalfa and the clovers, should be cut as soon as they are well in bloom.

It is impossible to give definite rules for making and curing hay, as the processes must change with the kinds of plants from which the hay is made, with the yield, and with the climate. There are, however, a few general principles which should always be observed.

The best hay made from any crop is always that which is made the most quickly and with the least exposure to sun and air. Too much exposure to the sun bleaches the hay, making it less attractive when placed on the market and also less palatable and less digestible. Nearly all kinds of hay should be put in the windrow the day after they are cut, and many of the finer and lighter kinds, like Bermuda grass, Natal grass, and redtop, should be put in the shock. Even slow-drying hays, like cowpeas and alfalfa, should be raked into windrows as soon as well wilted to avoid the loss of leaves when handled too dry, and they can be put in shocks by the second day. (Fig. 9.) After hay has become half dried it will cure perfectly even when in shocks of considerable size, and it is much safer there than on the ground. As soon as the shocks are well cured and even before they become bone dry in the middle they should be hauled to the barn or stack to avoid damage from rain. The bleaching on the outside of the shocks injures the hay, and the sooner it can be put into the barn after being cut the better will be its quality.

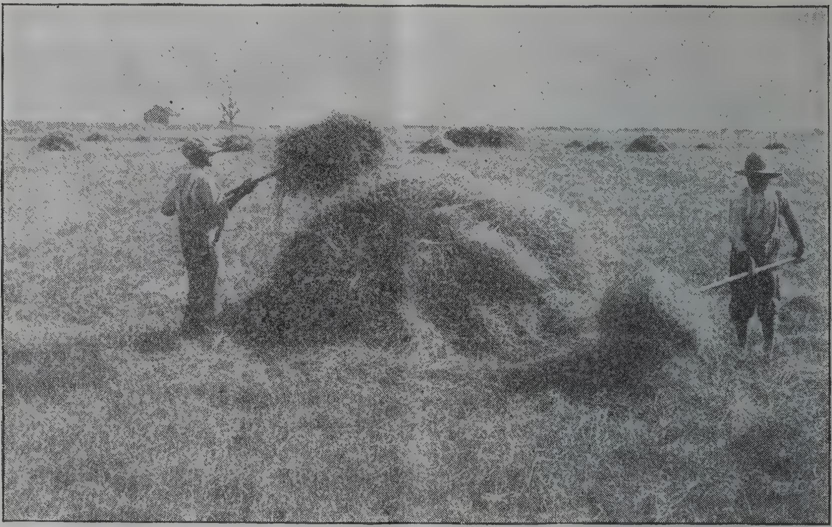


FIG. 9.—Placing alfalfa hay in the cock.

PASTURES.

Much of what has been said in relation to the formation of meadows applies equally well to the formation of pastures, except that in a field designed for a permanent pasture a much greater variety of plants is desirable. Bermuda grass and carpet grass are the foundation of all good permanent pastures in the cotton region, the former being superior on all heavy soils, the latter on lighter sandy soils. One or both of these grasses, together with any others that promise success, should be planted in every pasture. In the South pastures should give good grazing during eight or nine months of the year and some grazing during the other three or four months. While Bermuda grass and carpet grass are superior for general use, both start slowly and when first planted should be supplemented with some kind of rye-grass for a quick winter growth, orchard grass for woods pastures, redtop for wet ground, and Dallis grass for heavy clays. Every permanent pasture should have a good proportion of legumes, and of these lespedeza, melilotus, bur clover, vetch, white clover, and alsike clover are the most satisfactory. Lespedeza is best for the dry clay hills and melilotus for lands rich in lime, and lespedeza, bur clover, and the vetches are valuable additions to Bermuda grass sod. White clover comes in naturally in every pasture, and alsike clover should be sown on all wet or heavy soils.

Wild lands will furnish a certain amount of grazing, and even when they can not be plowed their natural condition can often be greatly improved by going over them with a heavy harrow or a disk and then seeding with forage crops suited to the conditions. To make a good pasture on land which has never been cultivated is a very slow process. Wherever it can be done it will pay to plow and harrow the ground, even where trees and stumps are so numerous that not more than half the surface can be disturbed. A really good pasture requires as good soil, as much work in its preparation, and as careful handling as any field on the farm. After the ground has been plowed or disked and the seed sown, grazing should be delayed until the young plants become so firmly rooted that they will not be pulled out by the grazing animals. When seeding is done in the fall the field should never be grazed until the spring growth is well started.

PASTURE WEEDS.

There are two weeds which sometimes make serious trouble in permanent pastures—the bitterweed and the garlic, or wild onion. Bitterweed may be held in control by mowing often enough to prevent its seeding, usually twice in a season. The destruction of the wild onion is a more difficult matter. It can be killed by a very deep plowing of the ground in September or October, followed by a very shallow plowing in the spring, and then planting the field with some cultivated crop. However, this method can not be followed in an ordinary pasture where there are many trees or in any pasture without destroying the grass and so making the field useless as a pasture for about 18 months. When a pasture is not infested it should be watched closely, and any wild onions which make their appearance should be removed promptly.

TEMPORARY PASTURES.

Temporary pastures for summer use require less attention to planting than to fencing, as nearly every field will give a few weeks of good grazing in the intervals between the regular crops, and when properly fenced will give most of the summer grazing needed on farms where cotton and grains are the principal crops. Winter pastures need special preparation and care and are practically limited to the growing of small grains and vetches for horses and cattle. Rye, where it can be successfully grown, makes an exce[illegible] winter pasture. Oats or wheat and vetch make the [illegible]ry best gr[illegible] from December to April and the best pasture for d[illegible] Mississippi Agricultural Experiment Station a mi[illegible] and hairy vetch has been in use many years, the s[illegible] in September and the fields ready for grazing in [illegible] growth is usually sufficient to support thr[illegible] co[illegible] number can be largely increased as the s[illegible] and mules do not eat the vetch greedily, b[illegible] them good grazing from January to Ap[illegible] pastures begin to furnish abundant feed. [illegible] or wheat and a peck of vetch seed are suf[illegible] an acre, while if the Rustproof oat is used the qua[illegible] be increased about one-half.

It is sometimes difficult to secure constant fresh grazing in the northern part of the cotton region in unfavorable seasons, but in the central and southern parts it is quite possible to have pasture crops, especially for cattle and hogs, during the entire year. Among the crops which can be used for this purpose are the following:

January and February: Wheat, oats and vetch, artichokes, rape, bur clover, velvet beans.

March: Oats and vetch, artichokes, rape, bur clover, crimson clover.

April: Oats and vetch, rape, bur clover, alfalfa, crimson clover.

May: Oats and vetch, rape, red clover, alfalfa, crimson clover.

June and July: Sorghum, cowpeas, red clover, alfalfa, Rhodes grass.

August: Sorghum, cowpeas, soy beans, alfalfa.

September and October: Sorghum, cowpeas, soy beans, chufas, sweet potatoes, Rhodes grass, corn, peanuts.

November: Cowpeas, soy beans, chufas, sweet potatoes, corn, rape, peanuts.

December: Cowpeas, chufas, sweet potatoes, corn, rape, velvet beans.

It is not to be expected that all of these will do well on any one plantation, but a selection can be made from the list to fit conditions on nearly any farm.

SILAGE CROPS.

While the silo is of less importance in the cotton region than in regions of shorter grazing seasons, it is usually a profitable investment for the dairyman. It provides supplies of succulent feed through the dry weather, which is almost sure to occur in late summer, as well as in the winter when the pastures are too scant or too wet for grazing. Corn and sorghum are the principal crops for making silage, but the quality of the feed made from them is greatly improved when mixed with even a small proportion of some legume, like cowpeas, soy beans, or beggarweed.

Some of the early-ripening varieties of velvet beans, like the Alabama and the Yokohama, are often used, as the vines twine about the corn so that they can be handled easily when being run through the [illegible]ler and still do not grow sufficiently large to tangle the corn. [illegible] made from this mixture is likely to be very dark in color, but [illegible] nutritious and is eaten readily.

[illegible] beggarweed and cowpeas or soy beans is often used [illegible] region, the beggarweed stems making the pea [illegible] handle and being of the highest value for giving [illegible] sweeter butter. It is seldom possible to have [illegible] fill the silo, but if as much as one-tenth of they can not be [illegible] remainder corn the whole contents of the improved by going [illegible] for the bulk of the silage, corn is usually then seeding with [illegible] the largest growing varieties of corn should be used [illegible] planted much more thickly than for grain. The crop should [illegible] when the kernels begin to glaze and before the lower leaves become dry. Sorghum is often used for silage and has the advantage of remaining green and in good condition much later in the season, thus lengthening the period during which the silo may be filled.

Japanese sugar cane is also valuable for silage, some preferring it to either corn or sorghum, particularly for dairy cows. The outside covering of cane is very hard, and if cane is used it should be cut into very short pieces so that the covering will be partially crushed and will not cut the mouths of the cattle.

SOILING CROPS.

Soiling is often more economical than grazing, especially where land is expensive, as it enables the farmer to keep fully three times the number of animals on the same area. Its principal use is for the dairy. Though the character of the feed is practically the same as that from temporary pastures it is used much more economically, being gathered only as needed and without injury to the roots, so that the plants make a second growth much more quickly and vigorously than when grazed and trampled. One successful dairyman near Harmony, Ga., reports that he keeps an average of 5 cows per acre with his soiling crops, while another near Atlanta states that he kept 25 cows in good condition from the middle of June until the last of September by the use of Amber sorghum grown on 2½ acres.

A profitable soiling crop requires a rich soil in good condition, and the field should be near the feeding lot, to save labor in hauling. The most productive soiling crops for general use are oats, vetch, and alfalfa for March, April, and May; alfalfa and Johnson grass for May and June; alfalfa, millet, and sorghum from June to October. Of course, the choice must depend largely on the location and soil of the particular field on which the crop is to be grown. On soils where alfalfa can not be grown it is generally possible to use vetches, cowpeas, or soy beans in its place. On very rich soil in the extreme

South teosinte makes a heavier yield than any other forage crop. In the southern half of the cotton region Napier grass outyields most other crops and makes a high quality of feed. Many prefer rye or wheat to oats for an early crop, while rice is valued highly in sections where it can be grown. Guinea grass gives frequent and heavy cuttings along the Gulf coast and in Florida, and German millet is ready for use in about 40 days from planting. It is usually better to make successive plantings of annual soiling crops, so that all the crop from each planting can be used just as it reaches its best condition and before it becomes so mature and dry as to lose its succulency. Soiling crops are always profitable when a large quantity of fresh feed is wanted from a limited area of ground, but less so when good summer pastures are available.

RECOMMENDATIONS BY THE AGRICULTURISTS OF SOUTHERN EXPERIMENT STATIONS.

Owing to the great number of forage crops adapted to the cotton region there is room for considerable difference of opinion as to the best sorts for use in any given locality. Table I summarizes the recommendations of the experts at each of several southern experiment stations. These recommendations were given, on request, by Prof. C. B. Williams, of North Carolina; Prof. C. B. Blackwell, of South Carolina; Director P. H. Rolfs, of Florida; Director J. F. Duggar, of Alabama; Director E. R. Lloyd, of Mississippi; Director W. R. Dodson, of Louisiana; Director Martin Nelson, of Arkansas; and Prof. A. B. Conner, of Texas. Corn is intentionally omitted from this table, except as to Florida, because it is considered primarily a grain crop, though also furnishing much forage and often grown for forage alone.

TABLE I.—*Forage crops recommended for certain States in the cotton belt.*

Character of crop.	Florida (Rolfs).	Eastern Texas (Conner).	Arkansas (Nelson).	Alabama (Duggar).	Mississippi (Lloyd).	North Carolina (Williams).	Louisiana (Dodson).	South Carolina (Blackwell).
Annual winter crops for hay.	Oats.............	Hairy vetch, oats.	Rye, oats, hairy vetch.	Oats, hairy vetch..	Oats, hairy vetch, crimson clover.	Oats, oats and vetch, crimson clover.	Oats, hairy vetch, red clover, crimson clover.	Oats, hairy vetch, rye, wheat.
Annual summer crops for hay.	Cowpea, beggarweed, soy bean,[1] sorghum, Mexican clover,[1] crab-grass, millet.	Cowpea, sorghum, peanut, Sudan grass.	Cowpea, sorghum, soy bean, lespedeza, oats, Sudan grass.	Cowpea, sorghum, lespedeza, soy bean.	Cowpea, lespedeza, peanut, sorghum, soy bean.	Cowpea, soy bean, sorghum.	Cowpea, lespedeza, peanut, soy bean; cowpea and sorghum mixed (for hill soils).	Cowpea, sorghum, soy bean, German millet, sweet-potato vines, Sudan grass, velvet bean.
Annual crops for winter pasture.	Velvet bean, rape, oats, rye.	Oats, bur clover, rescue grass.	Rye, bur clover, crimson clover.	Bur clover, oats and vetch, rescue grass, rye.	Oats, barley, rye, bur clover, rescue grass, hairy and common vetch.	Oats, oats and vetch, crimson clover, rye, Canada field peas and oats, rye and crimson clover, bur clover, rape.	Oats, rye, rescue grass, velvet bean.	Barley and vetch, oats and vetch, wheat and vetch, rye and vetch, crimson clover, bur clover, Italian rye-grass, velvet bean.
Annual crops for summer pasture.	Sorghum, peanut, crab-grass.	Cowpea, lespedeza, peanut, Sudan grass, sorghum.	Cowpea, lespedeza, peanut, soy bean, sorghum.	Lespedeza, soy bean, peanut, cowpea.	Cowpea, lespedeza, soy bean, peanut, sorghum.	Cowpea, lespedeza, soy bean.	Lespedeza, cowpea, peanut.	Cowpea, soy bean, peanut, chufa, lespedeza, white clover.
Permanent hay meadows.	Rhodes grass, Para grass, Natal grass (central and southern Florida), Johnson grass.	Bermuda grass and lespedeza mixed. Alfalfa, Johnson grass, rescue grass, and bur clover mixed. Rhodes grass.	Orchard grass, tall meadow oat-grass, alsike clover, redtop, timothy, and red clover mixed. Alfalfa, Johnson grass.	Alfalfa, Johnson grass, melilotus, Bermuda grass, and lespedeza mixed.	Bermuda grass, Johnson grass, alfalfa, melilotus, red clover.	Redtop, orchard grass, alsike clover, mammoth clover, and timothy mixed.	Bermuda grass and lespedeza mixed. Alfalfa, Johnson grass, carpet grass, paille finne.	Johnson grass, Bermuda grass, redtop, orchard grass, perennial rye-grass, Dallis grass, and lespedeza mixed.
Best permanent pastures.	Bermuda grass, Dallis grass, Para grass (central and southern Florida), Carib grass, Johnson grass.	Bermuda grass, carpet grass, lespedeza, bur clover, white clover, and Rhodes grass mixed.	Bermuda grass, lespedeza, white clover, and bur clover mixed. Redtop, orchard grass, and alsike clover mixed.	Bermuda grass and bur or white clover mixed. Johnson grass and bur clover mixed.[2]	Bermuda grass, lespedeza, bur clover, white clover, alsike clover, Johnson grass, redtop, orchard grass, and melilotus mixed.	Bermuda grass and lespedeza mixed, for uplands in the Coastal Plain.[3]	Bermuda grass, carpet grass, lespedeza, bur clover and white clover mixed.	Alfalfa, Rhodes grass, Bermuda grass, lespedeza, white clover, and Dallis grass mixed.

---

[1] For northern and western Florida.

[2] Orchard grass should be added on good uplands and redtop on moist lowlands.

[3] Redtop, perennial rye-grass, tall meadow oat-grass, and alsike clover mixed, for lowlands in the Coastal Plain; orchard grass, redtop, bluegrass, and red clover mixed, for the Piedmont Plateau and mountain uplands.

INDEX TO GRASSES AND FORAGE CROPS.

[The page numbers of the principal entries are in **heavy-face type**.]

Page.
Alalfa 21, **29–31**, 35, 53, 56, 58, 59,
Alsike clover **32–33**, 57
Annual yellow melilotus 32
Artichoke, Jerusalem 47, **50**, 58
Australian oats 20–21
Barley 23
Bean, soy **37–38**, 55, 58, 59
    velvet **38–42**, 58
Beggarweed, Florida **44–45**, 48, 54, 58, 59
Bermuda grass **5–8**, 19, 35, 41, 52, 53, 55–57
    grass, giant 7
Black medic 34–35
Bluegrass, Kentucky 20
Bokhara clover **31**, 32, 57
Bull-grass 11
Bur clover 21, 35, 57, **58**
Cane, Japanese sugar 24, **26–27**, 59
    Louisiana sugar 26–27
    maiden 18–19
Carib grass **13**, 54
Carpet grass **8–9**, 56
Cassava 47, **50–51**
Chufa 47, **49**, 58
Clover, alsike **32–33**, 57
    Bokhara **31**, 32
    bur 21, 35, 57, **58**
    crimson **33–34**, 55, 58
    Japan **34**, 54, 57
    Mexican 47, **48**, 54
    red **32**, 53, 58
    white 33, 57
    white sweet **31**, 32
Colorado grass, or Texas millet 23
Corn 39–41, 43, 55, **58**, 59
Cowpea 12, **35–37**, 51, 54, 55, 56, 58, 59
Crab-grass **17**, 23, 44, 48, 54
Crimson clover **33–34**, 55, 58
Dallis grass **10–11**, 54, 56
Florida beggarweed **44–45**, 48, 54, 58, 59
Giant Bermuda grass 7
Golden-crown grass 10

Page.
Grass, Australian oats 20–21
    Bermuda **5–8**, 19, 35, 41, 52, 53, 55–57
    Carib **13**, 54
    carpet **8–9**, 56
    cereals 23
    Colorado 23
    Dallis **10–11**, 54, 56
    fodder, coarse 23–28
    golden-crown 10
    Guinea **13–14**, 60
    Johnson **9**, 13–14, 43, 52–53, 55, 59
    kikuyu 17–18
    meadow 51–55
    Merker 28
    Napier 24, **27–28**, 60
    Natal **16–17**, 54, 56
    orchard **19**, 21, 56
    paille finne **18–19**, 54
    Para **11–13**, 14, 54
    pasture crops **5–23**, 61
    rescue 20–21
    Rhodes **14–16**, 54, 58
    St. Lucie 7
    Schrader's 20–21
    Sudan 10
    Vasey 11
    water 10
Guinea grass **13–14**, 60
    See also Johnson grass 13
Herd's-grass **20**, 33, 56
Japan clover **34**, 54, 57
Japanese sugar cane 24, **26–27**, 59
Jerusalem artichoke 47, **50**, 58
Johnson grass **9**, 13–14, 43, 52–53, 55, 59
    See also Guinea grass 13
Kentucky bluegrass 20
Kikuyu grass 17–18
Kudzu 45–47
Large water grass 10
Legumes 28–47
Lespedeza **34**, 54, 57
Louisiana sugar cane 26, 27

Page.
Maiden cane 18–19
Medic, black 34–35
Melilotus **31**, 35, 57
  annual yellow 32
Merker grass 28
Mexican clover 47, **48**, 54
Millet **21–23**, 43, 54, 55, 59
  common 21
  German **21–22**, 60
  Hungarian 21
  Texas 23
Napier grass 24, **27–28**, 60
Natal grass **16–17**, 54, 56
Oats **23**, 34, 43, 55, 58, 59, 60
  Australian 20–21
Orchard grass **19**, 21, 56
Paille finne **18–19**, 54
Para grass **11–13**, 14, 54
Paspalum 10
  smooth 10
Peanut **47**, 49, 58
Pifine **18–19**, 54
Potato, sweet 47, **49–50**, 58
"Purslane" 48
"Pusley," or "purslane" 48
Rape 47, **49**, 58
Red clover **32**, 53, 58
Redtop, or herd's-grass **20**, 33, 56
Rescue grass 20–21
Rhodes grass **14–16**, 54, 58
Rice **23**, 60

Page.
Rye **23**, 43, 60
Rye-grass 56
  Italian **19–20**, 21, 53
  perennial 19–20
St. Lucie grass 7
Schrader's grass 20–21
Sorghum **24–25**, 35, 54, 58, 59
  sumac 24
Soy bean **37–38**, 55, 58, 59
Sudan grass 10
Sugar cane 26
  Japanese 24, **26–27**, 59
  Louisiana 26–27
Sweet clover, white **31**, 32
Sweet potato 47, **49–50**, 58
Teosinte 24, **25**, 60
Texas millet 23
Timothy 21
Trefoil, yellow 34–35
Vasey grass 11
Velvet bean **38–42**, 58
Vetch 21, **42–44**, 55, 57, 58, 59
  Augusta 42, **43–44**
  common 42, **44**
  hairy 42, **43**, 55, 58
Water grass, large 10
Wheat **23**, 55, 58
White clover 33, 57
White sweet clover **31**, 32
Yellow melilotus, annual 32
Yellow trefoil 34–35

○

INDEX.

	Farmers' Bulletin No.	Page.
Aberdeen Experiment Station, Idaho, growing grain under irrigation	1103	18–28
Agriculture, relation of crow, bulletin by E. R. Kalmbach	1102	1–20
AICHER, L. C., bulletin on "Growing irrigated grain in southern Idaho"	1103	1–28
Alabama—		
citrus-growing conditions	1122	6–7, 13
corn cultivation, cost	1121	24
Alfalfa—		
growth habits, seeding, soil requirements, etc	1125	29–31
pasturing, carrying capacity, etc., practices in cotton States	1125	30–31
seeding, soil inoculation, etc	1125	30–31
Alsike clover, description and value for cotton States	1125	32–33
Ammoniacal copper carbonate, spray formula	1120	12
Aphids, spread by Argentine ant	1101	4
Ant, Argentine, as household pest, bulletin by E. R. Barber	1101	1–11
Ants—		
Argentine—		
control plans for municipal work	1101	11
nesting habits, social organization, and spread	1101	4–6
trapping directions	1101	11
Apple—		
powdery mildew—		
control, bulletin by D. F. Fisher	1120	1–14
See also Powdery mildew.		
pruning, for control of powdery mildew	1120	7–8
spraying, for control of powdery mildew, time and materials	1120	8–14
Apples—		
injury by powdery mildew, description	1120	4–6
varieties susceptible to powdery mildew	1120	3
Argentine ant as household pest, bulletin by E. R. Barber	1101	1011
Artichokes—		
grazing for hogs, feed value with corn, etc	1125	50
Jerusalem, growing in cotton States, value, etc	1125	50
Augusta vetch, growth habits, and seeding mixtures	1125	44
Australian oats. *See* Rescue grass.		
BACK, E. A., bulletin on "Book lice or psocids: Annoying household pests"	1104	1–4
Banding—		
furniture, against Argentine ant	1101	6–8
tree, against Argentine ant	1101	6–8
BARBER, E. R., bulletin on "The Argentine ant as a household pest"	1101	1–11–
Barley, growing under irrigation, southern Idaho	1103	24–26
Beans, velvet, growing in cotton States, value and uses, and seeding rate	1125	38–42
Beggarweed, Florida, description and value for cotton States	1125	44–45
Bermuda grass—		
description, value for hay and pasture in cotton States	1125	5–8
eradication, methods	1125	7–8
planting roots and cuttings, practices	1125	5–7
Bitterweed, occurrence in pastures, extermination, etc	1125	57
Black medic—		
description and value for cotton States	1125	34–35
seeding, inoculation of seeds, value with Bermuda grass, etc	1125	35
Blue ointment, use against chicken mites and lice	1110	5
Blue bugs, description and control	1110	8, 9
Bokhara clover. *See* Melilotus.		

	Farmers' Bulletin No.	Page.
Book lice—		
annoying household pests, bulletin by E. A. Back	1104	1–5
bulletin by E. A. Back	1104	1–4
control in houses	1104	4
habits, and conditions favorable to their increase	1104	2–4
Bordeaux mixture, formulas for apple spraying	1120	12–13
Breeding—		
poultry, age of breeding stock	1116	7
stock, poultry, selection and care, bulletin by Rob R. Slocum	1116	1–10
Brooder, emergency, directions for making	1108	5–6
Brooders, use in growing chicks	1111	3–4
BROWN, RALPH H., bulletin on "Dockage under the Federal wheat grades	1118	1–26
spot—		
corn, control	1124	9
corn, description, damages, cause, and control	1124	3–9
corn, with suggestions for its control	1124	1–9
Bud wood, citrus, selection	1122	22
Buildings, chicken houses for large and small flocks	1113	4–6
Bull-grass. *See* Vasey grass.		
Candling, egg, directions	1109	6–7
Cane, Japanese sugar, forage crop for cotton States	1125	26–27
Carib grass, description and value for cotton States	1125	13
Carpet grass, description and value for cotton States	1125	8–9
Casein, spray formula	1120	13
Cassava—		
growing in cotton States, value, etc	1125	50–21
planting, directions	1125	50–51
Cereal grasses, value for cotton States	1125	23
Champlain log scale	1117	18
Cheat, growing in oat fields, use as hay	1119	18
Chicken—		
houses, cleanliness	1110	9
pox, poultry disease, symptoms and control	1114	6
Chickens—		
breeding stock, selection and care, bulletin by Rob R. Slocum	1116	1–10
diseases, common, bulletin by D. M. Green	1114	1–8
culling for eggs and market, bulletin by Rob R. Slocum	1112	1–8
houses for large and small flocks	1113	4–6
feed, sprouted oats preparation	1105	7
feeding methods, and essentials in diet	1105	5–7
killing, picking, and preparing for market	1105	7–8
lice, mites, and cleanliness, bulletin by J. W. Kinghorne and D. M. Green	1110	1–10
marketing—		
discarded fowls, suggestions	1112	8
suggestions for discarded fowls	1112	8
mature, care of	1105	8
pure bred, advantages	1111	3–4
selection and preparation for exhibition, bulletin by J. W. Kinghorne	1115	1–11
shipping for exhibition, directions	1115	9–10
treatment for lice and mites	1110	3–9
washing to improve plumage, directions	1115	6–9
young, care of, brooding and feeding	1108	3–8
Chicks—		
baby, care of, bulletin by Alfred R. Lee	1108	1–8
care at hatching time	1108	3–4
growing, management, bulletin by J. W. Kinghorne	1111	1–8
growth essentials	1111	3–6
toe-marking, note	1108	4
Chiggers, control as pest of poultry	1110	8–9
Chufas, growing for hogs in cotton States	1125	49

	Farmers' Bulletin No.	Page.
Citrus—		
fertilizers	1122	31–34
frost-injured, treatment of tree	1122	41–42
fruits—		
growing in the Gulf States, bulletin by E. D. Vosbury	1122	1–46
harvesting and marketing	1122	42
varieties for the Gulf States, descriptions and value	1122	15–20
grove, management, planting, pruning, cultivation, etc	1122	23–42
groves—		
locality and site selection, protection and soils	1122	7–11
protection from frost	1122	36–38
growing—		
cost and profits	1122	43–44
nursery methods	1122	23
hybrids, value for the Gulf States	1122	20
spray schedule, materials, enemy and directions	1122	38–39
stocks, desirable kinds	1122	20–21
top-working and bridge grafting, inarching, etc	1122	40
trees—		
cultivation methods, green manure, mulching	1122	28–31
frost injured, treatment	1122	41–42
planting directions	1122	24–27
propagation methods for Gulf States	1122	20–23
pruning directions	1122	27–28, 34–35
Clover—		
alsike, value for cotton States	1125	32–33
crimson—		
description, growth habits, and value for cotton States	1125	33–34
effect on corn yield in cropping system	1121	12–13
Mexican. *See* Mexican clover.		
red—		
growth habits, and value for cotton States	1125	32
seedling, quality of hay, etc	1125	32
Clovers, growth habits of different varieties, value for cotton States, etc	1125	32–34
Clubs, poultry, instructions for selection and preparation of exhibition fowls	1115	3–11
Coal tar, use on seed corn as deterrent for crows	1102	16
Colorado grass—		
description and value for cotton States	1125	23
seeding and soil requirements	1125	23
Cooperage stock, hardwood trees most valuable for	1123	
Coops—		
brood, and appliances, bulletin by D. M. Green	1107	1–8
chick, arrangement and care	1111	3–4
chicken, directions for making	1107	3–4
construction from boxes	1111	4
shipping, for exhibition fowls, description	1107	5–6
Corn—		
brown spot, with suggestions for its control, bulletin by W. H. Tisdale	1124	1–9
damages by brown spot, description	1124	4–6
growing, labor saving by use of machinery, Alabama	1121	24
harvesting methods for control of brown-spot disease	1124	9
protection from crows	1102	15–17
yields after crimson clover, Virginia experiment	1121	12–13
Cotton—		
belt, forage crops for, bulletin by S. M. Tracy	1125	1–63
farms in Georgia, variations in income and in practices	1121	5–8, 22– 23, 28–31
losses by delayed picking	1121	14, 18
yields, relation to farm income on Georgia farms	1121	7

	Farmers' Bulletin No.	Page.
Cowpeas—		
cutting and curing for hay	1125	39
growing—		
and value for cotton States	1125	35–37
in cotton States, value and uses, and seeding rate	1125	35–37
to increase crop yields in South	1121	8
Cows, dairy, quality as an influence on income	1121	19–20
Crab-grass, description and value for cotton States	1125	17
Creosote, use in treatment of fence posts	1117	26–27
Crimson clover—		
description, growth habits, and value for cotton States	1125	33–34
effect on corn yield in cropping system	1121	12–13
Crops—		
diversity, importance in citrus-fruit region	1122	4–5
injury by Argentine ants	1101	4
protection from crows, methods and practices	1102	15–19
rotation in irrigation district of Southern Idaho	1103	10
yield, practices to maintain and increase	1121	8–17
yields, relation of farming system	1121	16–17
Crossties, hardwood trees valuable for	1110	8–9
Crow—		
agency in dissemination of diseases and seeds	1102	11
relation to Agriculture, bulletin by E. R. Kalmbach	1102	1–20
control, for protection of crops and poultry	1102	15–20
economic status, food habits	1102	7–15
species, distribution, life history and food habits	1102	4–15
Cuttings, hardwood trees, setting	1123	9, 10
Dallis grass—		
description and value for cotton States	1125	10–11
value for hay and winter grazing in South	1125	10–11
Diseases—		
chicken, causes and prevention	1114	3–8
poultry, bulletin by D. M. Green	1114	1–8
Dockage—		
value of system to wheat farmers	1118	7–8
wheat—		
definition and description	1118	3–5
determination method and equipment, details	1118	8–20
under Federal grades, bulletin by Ralph H. Brown	1118	1–26
value and handling methods	1118	7–8, 21–22
Doyle log scale	1117	17, 18
Drill, disk, use in seeding oats	1119	15
Drills, grain—		
description and use in seeding oats	1119	15, 16, 17
use and value in irrigation farming	1103	14
Dust, bath, for poultry, advantages	1110	9
Eastern United States, woodlands, extent and value of products	1117	4–7, 8, 16, 17, 29, 34
Eggs—		
candling directions	1109	6–7
cleaning, directions	1109	4
fertile—		
and infertile, uses and advantages	1109	5–6, 8
losses to farmers	1109	8
fertility, management of breeding stock for	1116	8–9
fresh, appearance in candling	1109	7
hens, incubation, bulletin by Harry M. Lamon	1106	1–8
incubation period for hens	1106	8
infertile, production	1109	5, 8
preparation for market	1105	7
preserved, keeping quality, and using	1109	3, 4
preserving—		
bulletin by J. W. Kinghorne	1109	1–8
in water glass	1109	3
requirements	1109	4, 7
with lime solution	1109	4

	Farmers' Bulletin No.	Page.
Eggs—Continued.		
production—		
culling for signs of good layers	1112	4–7, 8
rations for	1105	4–5
selection for hatching, instructions	1106	3
tester, homemade	1106	7
testing during hatching, directions	1106	7–8
Excelsior, hardwood trees most valuable for	1123	4
Exhibitions, poultry, value to club members, and importance of attending	1115	3, 10
Farm—		
forestry, growing and planting hardwood seedlings	1123	1–29
incomes, variations in Georgia cotton farms	1121	5–8, 28–29
records, importance, scope, suggestions, etc	1121	3–4
Farming—		
diversified, importance in citrus-fruit region	1122	4–5
practices that lower grade of product	1121	18–19
South, factors that make for success, bulletin by C. L. Goodrich	1121	1–31
systems, effect on crop yields	1121	16–17
Farms—		
forest plantation, care, cleaning, thinning, pruning, etc	1123	12–17
size, relation to income	1121	28–29
woodlands, extent in eastern United States, and value of products	1117	4–7, 8, 16, 17, 29, 34
Farmstead, planning for convenience, suggestions	1121	5–6
Feed, green, for young chicks	1111	5
Feeding—		
chick, directions	1108	6–7
chick in growing	1111	4–6
hen, rations, methods, and various kinds of feed	1105	4–7
poultry as breeding stock	1116	9
Feeds—		
chicks, needs for proper growth	1111	4–6
green, for chickens	1105	6–7
soy-bean products, value	1125	38
Fences, preservation of posts	1117	24–27
Fertilizers—		
application to citrus groves	1122	31–34
citrus tree	1122	31–34
oats	1119	11–12
Fire, protection of, woodlands	1117	20–21
Fires, forest, prevalence in eastern United States	1117	21
Firewood, uses on farms, Southern States	1117	7
FISHER, D. F., bulletin on "Control of apple powdery mildew"	1120	1–14
Fleas, stick-tight, poultry, pest, description and control	1110	7, 9
Florida—		
citrus—		
exchange, factor for improving industry in State	1122	5
fruit growing	1122	4–5
industry, history	1122	4–5
citrus-growing sections	1122	5, 11
State Horticultural Society, factor for improvement	1122	5
Fodder grasses, forage crops for cotton States	1125	23–28
Forage, crops for cotton belt, bulletin by S. M. Tracy	1125	1–63
Forest, planting stock, sources	1123	17
Forestry—		
departments, State directory	1123	28–29
farm—		
growing and planting hardwood seedlings, bulletin by C. B. Tillotson	1123	1–29
relation to farm income, bulletin by Wilbur R. Mattoon	1117	1–35
information sources, and publications, lists	1117	31–33
State departments and officials, list	1117	32
Forests, protection from fires, grazing, and insect damage	1117	20–23
Fountain, drinking, for chickens	1107	7

	Farmers' Bulletin No.	Page.
Fowls—		
exhibition, selection, and preparation, bulletin by J. W. Kinghorne	1115	1–11
washing for exhibition, management and directions	1115	6–9
Freezes, Florida, injury to citrus industry	1122	4
"Frenching", citrus trees, cause and treatment	1122	34
Frost—		
citrus grove protection in the Gulf States	1122	36–38
protection of citrus groves, methods	1122	36–38
Fumigation, use for control of book lice or psocids	1104	4
Fungus, cause of brown spot of corn, spores production, and germination	1124	7–8
Gapes, poultry, cause, symptoms, and control	1114	3–4
Garlic, occurrence in pastures, extermination	1125	57
Georgia—		
citrus growing conditions	1122	7
cotton farms, variations in income and in practices	1121	5–8, 22–23, 28–31
German millet, soiling crop for South	1125	21–22
Giant Bermuda grass, characteristics, note	1125	7
Golden-crown grass. *See* Dallis grass.		
GOODRICH, C. L., bulletin on "Factors that make for success in farming in the South"	1121	1–31
Grain—		
drills, use and value in irrigation farming	1103	14
feeds for growing chicks	1111	4–5
growing under irrigation in Southern Idaho, bulletin by L. C. Aicher	1103	1–28
supervision offices, post-office addresses	1118	26
Grapefruit—		
growing in Florida, location, number, and value	1122	11, 12
seedlings, use as stocks for citrus	1122	21
varieties for the Gulf States, description	1122	17
Grasses—		
coarse fodder, value for hay, grazing, silage, and soiling	1125	23–28
hay and pasture, for cotton States, descriptions	1125	5–23
Grazing—		
feed crop, to save labor	1121	26
injury to farm woodlands, control	1117	21–23
GREEN, D. M.—		
and J. W. KINGHORNE, bulletin on "Lice, mites, and cleanliness"	1110	1–10
bulletin on "Brood coops and appliances"	1107	1–8
bulletin on "Common poultry diseases"	1114	1–8
Grit, feeding to chickens, importance	1105	7
Grove, citrus, locality and site selection, protection, and soils	1122	7–11
management, planting, pruning, cultivation, etc	1122	23–42
Guinea grass—		
description and value for cotton States	1125	13–14
pasture, carrying capacity	1125	14
Gulf States, citrus-fruit growing, bulletin by E. D. Vosbury	1122	1–46
Hair balls, formation from crimson clover hay, danger to live stock	1125	34
Hairy vetch, growth habits, yield, and seeding methods	1125	43
Handle stock, hardwood trees most valuable for	1123	4
Hardwood, plantation establishment on farms	1123	7–12
Hardwoods—		
growth in diameter and height, by species	1123	4, 5
value for various purposes	1123	4
Harvesting—		
citrus fruits	1122	42
grain grown under irrigation	1033	26–27
oats for grain or hay	1119	18–20
practices, relation to farm income	1121	14, 18–19
sorghum for fodder	1125	24–25
soy beans for hay and for seed	1125	38
Hatching, eggs of hens	1106	8

	Farmers' Bulletin No.	Page.
Hay—		
cowpea—		
directions for making	1125	36
feeding value	1125	37
crimson clover, quality and caution	1125	34
crops—		
cotton region, plants for temporary meadows	1125	54–55
cotton States, permanent and temporary meadows	1125	51–56
grasses for cotton States, descriptions	1125	5–23
making, suggestions and practices	1125	55–56
oat, feed value	1119	21
sorghum, feed value	1125	25
Heaters, orchard, use, and value in citrus groves	1122	38
Henhouse, care	1105	3–4
Henhouses—		
breeding stock, care and arrangement	1116	9
large and small flocks	1113	4–6
Hens'—		
eggs, incubation, bulletin by Harry M. Lamon	1106	1–8
feeding and care	1105	3–8
layers, how to judge excellence	1112	4–7, 8
selection for eggs and breeding	1112	4–8
setting, directions for	1106	4–7
sitting, care of	1106	3–7
Herd's-grass. *See* Redtop.		
Hogs, gains on peanuts, quality of pork	1125	47
Honeydew insects, keeping by Argentine ants	1101	4
Hopper, feeding, for dry mash to growing chicks	1111	5
Household pest—		
Argentine ant, bulletin by E. R. Barber	1101	1–11
book lice or psocids, bulletin by E. A. Back	1104	1–4
Houses—		
chicken, cleanliness and care	1111	4
infestation with Argentine ants, and prevention methods	1101	3, 7–8, 9–11
Idaho, Southern, growing irrigated grain, bulletin by L. C. Aitcher	1103	1–28
Income, farm, relation to forestry, bulletin by Wilbur R. Mattoon	1117	1–35
Incomes, farm, variations in Georgia cotton farms	1121	5–8, 28–29
Incubation—		
eggs of hens, bulletin by Harry M. Lamon	1106	1–8
period for hens' eggs	1106	8
Insect—		
damages to woodlands, prevention	1117	23
powder, use on sitting hens	1106	4
Insects—		
destruction by crows	1102	7–10, 13–14
poultry, control on sitting hens	1106	4
Iron sulphid spray, formulas	1120	2
Irrigation—		
citrus, in Gulf States	1122	35–36
methods in Southern Idaho	1103	14–18
Southern Idaho, preparation of land, importance	1103	7–10
Japan clover. *See* Lespedeza.		
Japanese sugar cane—		
forage crop for cotton States	1125	26–27
sirup yield	1125	27
Johnnycake—		
feeding to chicks, note	1108	6
recipe for chicks	1108	6
Johnson grass, description and value for cotton States	1125	9
KALMBACH, E. R., bulletin "The crow in its relation to agriculture"	1102	1–20
Kentucky bluegrass, description and value for cotton States	1125	20
Kikuyu grass—		
description and value for cotton States	1125	17–18
introduction and value for pasture	1125	17–18

	Farmers' Bulletin No.	Page.
KINGHORNE, J. W.—		
and D. M. GREEN, bulletin on "Lice, mites, and cleanliness"	1110	1–10
bulletin on "Management of growing chicks"	1111	1–8
bulletin on "Preserving eggs"	1109	1–8
bulletin on "Selection and preparation of fowls for exhibition".	1115	1–11
Kudzu—		
description and value for cotton States	1125	45–47
growth habits, planting methods, and grazing value	1125	45–46
Kumquats—		
growing in Gulf States	1122	12
varieties for the Gulf States	1122	20
Labor, efficiency in use of, and means of saving	1121	21–27
LAMON, HARRY M., bulletin on "Incubation of hens' eggs."	1106	1–8
Lantern slides, forestry subjects, loaning to educational agencies	1117	33
LEE, ALFRED R., bulletin on—		
"Care of baby chicks"	1108	1–8
"Care of mature fowls"	1105	1–8
"Poultry houses"	1113	1–8
Legumes—		
growing in South to increase crop yields	1121	8–14
use in cotton States for hay, pasture, and green manure	1125	28–47
Lemons—		
growing in Florida, location, number, and value	1122	12
varieties for the Gulf States, description	1122	18–19
Lespedeza—		
description, and value for cotton States	1125	34
seeding from hay, practices in South	1125	34
Lice—		
control on young chicks	1108	3
poultry—		
kinds and control	1110	3–6, 9
species and nature	1110	3–6
powders, use against chicken mites and lice	1110	5
Lime—		
solution, use in preserving eggs	1109	4
use and value for preserving eggs	1109	4
Lime-sulphur, use in spraying apple powdery mildew	1120	12,13
Limes—		
growing in Florida, location, number of trees, and value	1122	12
varieties for the Gulf States, description	1122	19
"Litter," for poultry, suggestions	1113	8
Live stock—		
feeding, oats, oat straw, and oat hay	1119	20–21
Southern Idaho, relation to agriculture	1103	3–4
young—		
feeding legume hay, value	1125	29
feeding oats, advantages	1119	20
Log scales, Champlain and Doyle	1117	16–18
Logs, marketing, special demands of industries	1117	19
Lolium multiflorum, value for lawns, etc	1125	19–20
Louisiana, citrus-fruit growing conditions	1122	5–6, 13
Lumber, hardwood trees most valuable for	1123	4
Machinery, labor-saving, on farms, Southern States comparisons	1121	22–25
"Maiden cane"—		
description and value for cotton States	1125	18–19
feed value	1125	18
Manure—		
green, value of legumes	1125	29
stable, use in citrus groves, precautions	1122	33–34
Marketing—		
citrus fruits	1122	42
poultry, suggestions	1112	8
woodland products, helpful suggestions	1117	14, 19, 35

	Farmers' Bulletin No.	Page.
Mash—		
chicken feed, preparation and feeding	1105	5–6
dry, formula, for chicks	1111	5
formula for young chicks	1108	7
Mating, poultry, object, time and size of matings	1116	4–7
MATTOON, WILBUR R., bulletin on "Forestry and farm income"	1117	1–35
Meadows, permanent—		
cotton region, requirements and preparation	1125	51–52
cotton States, plants suitable	1125	52–54
Mealybug, spread by Argentine ant	1101	4
Medic black. *See* Black medic.		
Melilotus—		
description and value for cotton States	1125	31–32
growth habits, seeding, and value for land	1125	31
Mercury, bichlorid, use to poison ants, precautions	1101	7, 8
Merker grass, description, and value for cotton States	1125	28
Mexican clover—		
description, and value for cotton States	1125	48
grazing capacity, growth in mixtures, etc	1125	48
Mildew, apple powdery—		
control, bulletin by D. F. Fisher	1120	1–14
economic importance	1120	3
description, occurrence and causes	1120	4–5
Milk—		
feed value for chicks	1108	7
sour, value for young chicks	1111	5–6
Millet, growing for hay, practices and yields	1125	21–22
Millets, descriptions, and varieties valuable for cotton States	1125	21–23
Mine timbers, hardwood trees most valuable for	1123	4
Minnesota, wheat yields, relation to farming systems	1121	16
Mississippi, citrus growing, conditions	1122	6–7, 13
Mites—		
poultry, description, habits, and control	1110	6, 9
poultry, nature and control	1110	6
Molting, characteristics of good hens	1112	4–5
Mottle-leaf, citrus trees, cause and treatment	1122	34
Mulching, citrus orchards	1122	30
Mule, efficiency on cotton farms, comparisons	1121	21–22
Natal grass—		
description and value for cotton States	1125	16–17, 27–28
planting directions	1125	28
yield and quality of hay	1125	17
Nests, hens—		
construction and distribution in poultry house	1113	8
for sitting	1106	3–4
New Hampshire, farm woodlands, examples of value	1117	8, 29
New York, woodland products, notes	1117	7
North Carolina, woodland products, value	1117	7
Nurse crops, irrigated section, southern Idaho	1103	11
Nut trees, planting methods	1123	7, 9, 24
Nuts—		
seed, storage directions	1123	20–21
sprouted, planting	1123	9, 24
Oats—		
Australian. *See* Rescue grass.		
fall, acreage and location	1119	3–4
fall-sown—		
advantages	1119	4–6
area	1119	34
bulletin by C. W. Warburton and T. R. Stanton	1119	1–21
comparison with spring-sown	1119	4–6
pasturing precautions	1119	17
uses in the South	1119	20–21

	Farmers' Bulletin No.	Page.
Oats—Continued.		
feeding to live stock, methods and value	1119	22
fertilizers	1119	11–10
Fulghum, description	1119	7
growing under irrigation, southern Idaho	1103	22–23
pasture value	1119	17, 21
red rustproof, description	1119	6, 7, 9
seed—		
bed preparation, directions	1119	13
preparation, cleaning, and treatment for smut	1119	13–14
seeding, time, method, and rate, in fall sowing	1119	14–17
soils for	1119	9–11
sprouting for chicken feed	1105	7
value for winter pastures and for hay in South	1125	23
varieties for fall sowing, description	1119	6–9
winter—		
harvesting for grain or hay	1119	18–20
turf, description, and value for fall sowing	1119	8–9
Oil, soy-bean, extraction and value	1125	38
Orange—		
growing in Florida, location, number of trees, and value	1122	11, 12
Satsuma, growing in Gulf States, locations, etc	1122	6, 7, 11, 13, 18
sour, value as citrus stock	1122	21
trifoliate, value as citrus stock	1122	21
Oranges—		
growing, cost and profits	1122	43–44
kid-glove, varieties for the Gulf States, description	1122	18
propagation, planting, and care	1122	20–42
round, varieties for the Gulf States, description	1122	15–17
Orchard grass, description and value for cotton States	1125	19
Orchards, citrus, protection from frost	1122	36–38
"Paille finne." *See* "Maiden cane."		
Panicum texanum. *See* Colorado grass.		
Para grass—		
description and value for cotton States	1125	11–13
hay yield, growing with cowpeas, advantages	1125	11–13
Paspalum. *See* Dallis grass.		
Pastures—		
cotton region, plants suitable, management, etc	1125	56–58
grasses for cotton States	1125	5–23
temporary for cotton region, plants suitable, seeding, etc	1125	58
Peanuts, growing and uses in cotton States	1125	47
Pennisetum longistylum. *See* Kikuyu grass.		
Pest, household—		
Argentine ant, bulletin by E. R. Barber	1101	1–11
book lice or psocids, bulletin by E. A. Back	1104	1–4
Pests, poultry, control by cleanliness	1110	8
Physoderma, corn disease, cause, development, description, and control	1124	3–9
"Pifine." *See* "Maiden cane."		
Planting, hardwood trees on farm, methods, season, and spacing	1123	7–12
Podosphaera leucotricha, cause of apple powdery mildew	1120	6
Poisons—		
ant, directions for use	1101	8–11
use against Argentine ant	1101	7, 8, 11
Poles, hardwood trees most valuable for	1123	4
Posts—		
fence, preservation	1117	24–27
hardwood trees most valuable for	1123	4
Poultry—		
breeding stock, selection and care, bulletin by Rob R. Slocum	1116	1–10
diseases, symptoms and control, bulletin by D. M. Green	1114	1–8
exhibitions, value to club members and importance of attending	1115	3, 10
exhibits, value	1115	3
houses, bulletin by Alfred R. Lee	1113	1–8

	Farmers' Bulletin No.	Page.
Poultry—Continued.		
preparation for market	1105	7–8
protection from crows	1102	15, 16
raising—		
care of baby chicks, bulletin by Alfred R. Lee	1108	1–8
publications list	1107 1108 1110 1114 1115	8 8 10 8 11
range for breeding stock	1116	8
selection and preparation for exhibition, bulletin by J. W. Kinghorne	1115	1–11
standard bred, advantages	1111	7
Powdery mildew, apple—		
control, bulletin by D. F. Fischer	1120	1–14
description, occurrence, and causes	1120	4–5
economic importance	1120	3
Propagation, citrus trees, methods for Gulf States	1122	20–23
Pruning—		
apple, for control of powdery mildew	1120	7–8
citrus, directions	1122	27–28, 34–35
forest trees on farm	1123	15–16
Psocids—		
or book lice, annoying household pests, bulletin by E. A. Back	1104	1–4
See also Book lice.		
Pueraria thunbergiana. *See* Kudzu.		
Pumpkin bugs, control in citrus groves	1122	30
Rape—		
description and value for cotton States	1125	49
grazing value and caution	1125	49
Rations, egg-laying, for hens	1105	4–5
Red bugs, control as pests of poultry	1110	8–9
Red clover, growth habits and value for cotton States	1125	32
Red lead, use on seed grain as deterrent for crows	1102	16
Redtop—		
description and value for cotton States	1125	20
value for wet lands	1125	20
Rescue grass—		
description and value for cotton States	1125	20–21
winter grazing, value	1125	20
Rhodes grass—		
description and value for cotton States	1125	14–16
hay cuttings and value	1125	16
Rice, second-growth, value for hay	1125	23
Roosts—		
crow, locations, and eradication methods	1102	6–7, 19, 20
poultry houses, location and arrangement	1113	7–8
Rotations, fall oats	1119	12
Roughage, sorghum fodder, value	1125	25
Roup, poultry disease, cause and treatment	1114	4–6
Rye, value for winter pastures and for hay in the South	1125	23
Rye-grass, Italian, growing with slow-starting grasses, value	1125	19
Rye-grasses, descriptions, and value for cotton States	1125	19–20
Saponin, spray formula	1120	13
Scale insects, spread by Argentina ant	1101	4
Scaly leg, poultry disease, cause and treatment	1114	6–7
Screening, wheat, for dockage determination	1118	4, 9–20
Seed—		
bed, oats, preparation directions	1119	13
beds, tree seedlings, location, preparation, and care of	1123	22, 27

Farmers' Bulletin No. — Page.

- Seed—Continued.
  - grain—
    - cleaning and treatment for irrigation crops, in Idaho ...... 1103 — 12
    - treatment with deterrents against animals, effect on germination ...... 1102 — 17
    - treatment with deterrents for crows ...... 1102 — 16–17
  - nuts, storage directions ...... 1123 — 20–21
  - oats, preparation, cleaning, and treatment for smut ...... 1119 — 13–14
- Seeding—
  - cereal crops in irrigated district, southern Idaho ...... 1103 — 13–14
  - oats, time, method, and rate, in fall sowing ...... 1119 — 14–17
- Seedlings, hardwood—
  - growing and planting on the farm, bulletin by C. B. Tillotson ...... 1123 — 1–29
  - growing directions ...... 1123 — 22–28
  - removal from nursery ...... 1123 — 27–28
  - sprouting, protection, shading, and cultivation ...... 1123 — 26–27
- Seeds—
  - distribution by crows ...... 1102 — 13
  - hardwood trees, sowing, methods, quantity, and season ...... 1123 — 10, 23–25
  - kinds found in wheat dockage ...... 1118 — 6, 8, 9, 10–12, 15–19
  - selection and care, factor in successful farming ...... 1121 — 15
  - tree—
    - collection, extraction, and storage ...... 1123 — 17–22
    - germination hastening methods ...... 1123 — 25–26
    - ripening in spring and summer, list and treatment ...... 1123 — 18, 19
    - storage methods adapted to various species ...... 1123 — 19–22
- Setting hens, directions for ...... 1106 — 4–7
- Shipping, fowls for exhibition, directions ...... 1115 — 9–10
- Sieves, wheat screening, description and use ...... 1118 — 4, 9–20
- Silage—
  - beggarweed, value for giving "June flavor" to winter butter, note ...... 1125 — 59
  - crops and mixtures for cotton States ...... 1125 — 24, 25, 35, 38, 58–59
  - sorghum, value ...... 1125 — 25
- Sirup, poisoned, use for control of Argentine ants ...... 1101 — 8–11
- SLOCUM, ROB R., bulletin on—
  - "Culling for eggs and market" ...... 1112 — 1–8
  - "The selection and care of poultry breeding stock" ...... 1116 — 1–10
- Smut—
  - grain, prevention by treatment of seed ...... 1103 — 12–13
  - oats, seed treatment for control ...... 1119 — 14
- Snake River Basin, southern Idaho, climate and soils ...... 1103 — 4–7
- Sodium—
  - arsenite, use in poisoned sirup for control of Argentine ants ...... 1101 — 8, 11
  - fluorid, use against chicken lice and mites ...... 1110 — 4–5
- Soil, inoculation, for alfalfa growing, methods ...... 1125 — 30–31
- Soiling—
  - crop, value of oats ...... 1119 — 20, 21
  - crops and mixtures for cotton States ...... 1125 — 13, 14, 24, 25, 27, 28, 29
- Soils—
  - citrus growing ...... 1122 — 10–11
  - oat growing ...... 1119 — 9–11
- Sorehead, poultry disease, symptoms and control ...... 1114 — 6
- Sorghum—
  - forage crop for cotton States ...... 1125 — 24–25
  - pasturing, practices and caution ...... 1125 — 25
- South—
  - farming, factors that make for success, bulletin by C. L. Goodrich ...... 1121 — 1–31
  - oats growing, fall-sowing and uses ...... 1119 — 3–4, 20–21
- Soy bean, seed, harvesting and germination ...... 1125 — 38

	Farmers' Bulletin No.	Page.
Soy beans—		
feeding value	1125	38
growth habits and value for cotton States	1125	37–38
seeding for hay and for silage	1125	38
value as fertility maker for South	1121	11
Soy-bean—		
cake, feed value	1125	38
oil, extraction and value	1125	38
Spacing, hardwood trees, and number required per acre	1123	12
Spraying—		
apples, for control of powdery mildew, time and materials	1120	8–14
citrus, materials, schedule, etc	1122	38–39
schedule for apple powdery mildew	1120	13–14
St. Lucie grass, characteristics, note	1125	7
STANTON, T. R., and C. W. WARBURTON, bulletin on "Fall-sown oats"	1119	1–21
Stocks, citrus, desirable kinds	1122	20–21
Storage, tree seeds, directions	1123	19–22
Straw, oat, feed value	1119	21
Sudan grass, description and value for cotton States	1125	10
Sulphur, fumigation, for household pests, precautions	1104	4
Sweet potatoes—		
grazing for hogs, value	1125	49
growing and value for cotton States	1125	49–50
vines as feed for cows, value	1125	49
yield in pine-wood region, value for feed, etc	1125	49–50
Tables, protection from ants	1101	7–8
Tangerine, growing in Gulf States	1122	12, 18
Teosinte—		
description and value for cotton States	1125	25
seeding, yield, feed value, etc	1125	25
Texas—		
citrus fruit growing, conditions	1122	6, 13
farm, labor requirements and cost	1121	22–23
millet. *See* Colorado grass.		
Thinning, woodlands, directions	1117	10–12, 13
Thrashing, grain in Idaho, practices and suggestions	1103	27–28
Ticks, fowl, description and control	1110	8, 9
Ties, railroad, hardwood trees most valuable for	1123	4
TILLOTSON, C. R., bulletin on "Growing and planting hardwood seedlings on the farm"	1123	129
Timber—		
estimating and selling from woodlands	1117	13–19
farm woodlands, value	1117	6, 7, 8, 29
measurement, and log scales	1117	13–18
preservation treatment	1117	24–27
using on farms, treating for preservation, etc	1117	23–27, 35
Timothy, growth habits, use in cotton States	1125	21
TISDALE, W. H., bulletin on "The brown spot of corn with suggestions for its control"	1124	1–9
TRACY, S. M., bulletin on "Forage for the corn belt"	1125	1–63
Trapping—		
ant, directions	1101	11
crows, methods and usefulness	1102	19
Trees—		
cutting and thinning in farm plantations	1123	13–14
cutting to improve woods, directions for thinning	1117	10–12, 13, 35
forest, planting, directions and examples	1117	27–31
mixtures for farm planting	1123	5–6
planting—		
in home woodlands, desirable kinds, etc	1117	27–31
information sources	1123	28–29
methods, slit, hole, furrow, seed spot, and broadcast	1123	8–11
protection against ants, banding mixtures	1101	6–7
seeds, collection, extraction, and storage	1123	17–22
spacing in plantation by species, and number required	1123	11–12

	Farmers' Bulletin No.	Page.
Vasey grass—		
description and value for cotton States	1125	11
introduction, value for wet land, etc	1125	11
Velvet beans—		
effects on oat crop following	1121	9
feeding to live stock, practices and caution	1125	42
growing and value for cotton States	1125	38–42
history, growth habits, and feed value	1125	38–42
seeding methods, yield, etc	1125	42
Veneer, hardwood trees most valuable for	1123	4
Vermin, poultry, kinds and control	1110	3–10
Vetches, growing in cotton States, value and uses, and seeding rate	1125	42–44
Virginia, cropping experiment to increase corn yields, results	1121	11–13
VOSBURY, E. D., bulletin on "Citrus-fruit growing in the Gulf States"	1122	1–46
WARBURTON, C. W., and T. R. STANTON, bulletin on "Fall-sown oats"	1119	1–21
Water—		
for chickens, fountain	1107	7
glass, use and value for preserving eggs	1109	3
grass, large. *See* Dallis grass.		
Weeds—		
control in oat fields	1119	18
seeds in wheat, description and screening	1118	10–12, 15–19
Wheat—		
dirt other than material considered in dockage	1118	5–7
dockage—		
determination method and equipment, details	1118	8–20
under Federal grades, bulletin by Ralph H. Brown	1118	1–26
growing under irrigation, southern Idaho	1103	19–21
samples for dockage determination, taking and grading	1118	8–9, 20–21
screening, for dockage determination	1118	4, 9–20
yields, influence of farming systems	1121	16–17
Whitewash—		
formula for chickenhouses	1110	9
preparation and use against poultry vermin	1110	9
use in chickenhouses	1110	9
Windbreaks—		
citrus groves	1122	9–10
hardwood trees most valuable for	1123	4
location on farms	1123	6–7
Woodland products, markets, special demands of industries	1117	19, 35
Woodlands—		
farm, extent in eastern United States, and value of products	1117	4–7, 8, 16, 17, 29, 34
improvement methods	1117	7–12, 35
protection from fire, grazing, and insect damage	1117	20–23, 35
Yellow trefoil. *See* Black medic.		

○

UNIVERSITY OF ILLINOIS-URBANA
630UN3F C001
FARMERS' BULLETIN WASHINGTON
1101-1125 1920
3 0112 019277778